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THE TROMBICULID MITES OF JAPAN

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The classical studies of tsutsugamushi disease in Japan long ago drew first attention to the chigger (trombiculid mite) fauna of that country, and for many years this disease and the associated chiggers were investigated and reported upon by Japanese workers. Because many of their reports are difficult to obtain and because of the previous lack of interest in chiggers, the western world had only a vague understanding of the Japanese species. Our knowledge of Oriental chiggers was greatly advanced during World War II: many species were described and the status of many previously named species was clarified. Following the war, there has been a resurgence in the taxonomic study of chiggers in Japan, and many new species have been described from this small country. Unfortunately, most of these descriptions are in Japanese and in journals of a limited distribution outside of Japan.

Studies upon which this paper is in part based were conducted under contract no. DA-49-007-MD-242, between the Regents of the University of California and the Medical Research and Development Board, office of the Surgeon General, Department of the Army. The work was initiated while the junior author was associated with the 406th Medical General Laboratory and Far East Medical Research Unit in Japan during the period January-October, 1952. Logistical support for the preparation of the illustrations was supplied by the U. S. Army Hospital, 8164 Army Unit, APO 9, by special arrangement with the above-mentioned organizations.

This paper presents a brief summary of the chigger fauna of Japan. Omissions are inevitable for new species are being described from Japan

almost every month; and before publication of this paper our list will be outdated. Nevertheless, we hope that the keys, diagnoses, and data with these illustrations will simplify the identifications of Japanese chiggers.

It would be premature to discuss the Japanese trombiculid fauna with regard to chiggers elsewhere; but from the list of chiggers already known from Japan, however, some comments are justified. We have listed here 6 genera and 45 species of chiggers in the Japanese fauna. Of the 45 species known from Japan, 27 are endemic: in view of the widespread geographic distribution of species of chiggers generally, it is remarkable that more than half of the known species in this tiny country seem to be confined to it.

The most important genus is *Trombicula*. Worthy of comment is the abundance both in numbers of individuals and in species of the subgenus *Leptotrombidium*; this group contains 18 species in Japan, and 14 of these are apparently confined there. Although the subgenus *Leptotrombidium* is well represented elsewhere in the Orient, there seems to be no such concentration of species in such a small area. This situation presents an interesting contrast to the fauna of adjacent North America where the group is rather scarce. The subgenus *Trombiculindus*, containing one species in Japan, is represented by four other species in the tropical Orient, and thus seems to be an austral element. The subgenus *Miyatrombicula* contains a single species (*T. (M.) kochiensis*) found on the islands of Skikoku, Kyushu, and southern Honshu. In contrast to the other groups of *Trombicula*, the subgenus *Neotrombicula*, with six species in Japan, contains two species that are also found in North America, and four species that occur on the adjacent Asiatic mainland. The single species of the subgenus *Eutrombicula* (*wichmanni*) in Japan is widespread and common in the southern Orient; avian hosts of this species make a wide geographic distribution easily understandable.

In Japan the genus *Euschöngastia* is scarce, and known from only four species; one of these (*E. ikaoensis*) has been found also in southern Korea. This state of affairs is vastly different from what obtains in North America where *Euschöngastia* is one of the dominant groups.

The genus *Neoschöngastia*, its members characteristically parasites of birds, is represented by six species in Japan; five of these occur elsewhere in the world, two of them having been described from North America. Theoretically, of course, they can be as widely distributed as their hosts; and because most species of *Neoschöngastia* appear not to be confined to a single species of host, they may easily be more widely distributed than any one host.

When the chigger faunas of the world are more completely known, we can better classify that of Japan. As we know it today, on the specific level the trombiculid fauna of Japan seems not closely allied to that of any other

region: the large number of endemic species justifies labelling the fauna as typically Japanese: that is, the species seem no more closely related to Oriental species than they are to Nearectic species. Generically, Japanese chiggers seem more typically Palaearctic than Oriental in affinities; many genera of the tropical Orient are not known to occur in Japan.

The illustrations in this paper were made in Kyoto, Japan, and represent the holotype wherever such was available. The staff of artists was under the direct supervision of Mr. K. Yamazaki; Mr. Yamazaki was assisted by Mr. A. Shimazoe, Mr. K. Daishoji, Mr. S. Shibata, Mr. M. Endo, Miss F. Tamara, and Miss C. Tanaka. For the excellence of their painstaking labors we are deeply appreciative. We wish to thank also Miss Y. Yoshida, technician and interpreter, who prepared the bulk of the material collected during the course of this study.

Dr. Mitosi Tokuda was of great assistance in collecting many of the specimens used in this paper. Special thanks are due Mr. Seiichi Toshioka

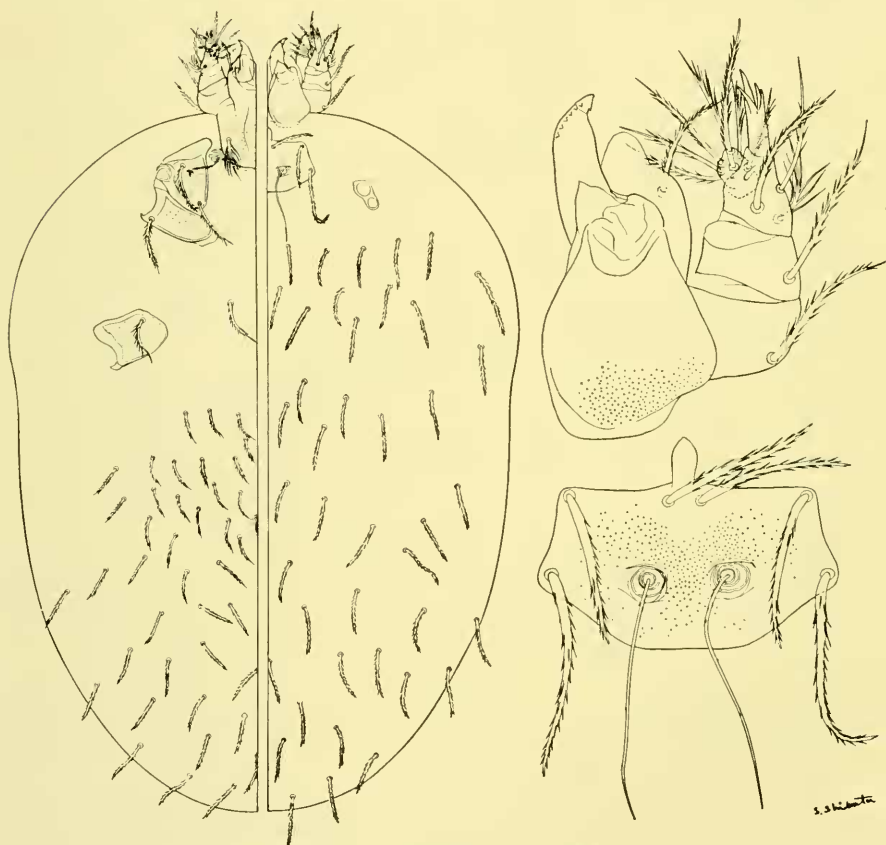


Fig. 1 *Acomatacarus yosanoi*

for his invaluable service in checking many of the scutal measurements used in this paper; and for collecting a large amount of the data on host and geographic distribution of Japanese chiggers.

We are greatly indebted to Dr. James M. Brennan for much council given during the preparation of this paper; and to Major Paul W. Oman, MSC, under whose administration this work was done.

KEY TO GENERA AND SUBGENERA OF CHIGGERS IN JAPAN

1. Coxa I with two setae.....genus *Acomatacarus*
- Coxa I with one seta..... 2
2. With no anteromedian seta.....genus *Gahrlepiea* 3
- With one anteromedian seta..... 4
3. Scutum with four marginal setae.....subgenus *Walchia*
- With more than four setae, some not marginal.....subgenus *Gahrlepiea*
4. Sensillae expanded distally..... 5
- Sensillae flagelliform.....genus *Trombicula* 7
5. Scutum partly submerged beneath the integument.....genus *Neoschöngastia*
- Scutum entirely on the surface of the integument..... 6
6. Coxa II with a single seta.....genus *Euschöngastia*
- Coxa II with more than a single seta.....genus *Doloisia*
7. Posterolateral setae greatly expanded, foliate.....subgenus *Trombiculindus*
- Posterolateral setae slender..... 8
8. Coxa III with several setae.....subgenus *Miyatrombicula*
- Coxa III with a single seta..... 9
9. With one or more mastitarsalae III..... 10
- With no mastitarsalae III..... 12
10. Scutum roughly pentagonal; palpal claw three-pronged.....subgenus *Neotrombicula*
- Scutum rectangular; palpal claw two-pronged..... 11
11. Axial prong (of palpal claw) external (or dorsal); with 20 or 22 dorsal setae.....subgenus *Eutrombicula*
- Axial prong (of palpal claw) internal (or ventral); with 30 or more dorsal setae.....ungrouped species
12. Palpal femoral and genual setae nude; galeal seta feathered; no mastitarsalae III; sternal setae 2-2; coaxal setae 1-1-1; scutum more or less rectangular.....subgenus *Leptotrombidium*
- Without the above combination of characters.....ungrouped species

***Acomatacarus yosanoi* Fukuzumi and Obata, 1953**

(Figure 1)

Acomatacarus yosanoi FUKUZUMI and OBATA, 1953, Kitasato Archives of Experimental Medicine, vol. 26, no. 2, pp. 1-22.

DIAGNOSIS: All palpal setae feathered; ventral tibial seta with long branches, other palpal setae very short, fine branches. Palpal claw four-pronged. Galeal seta with fine branches. Chelicera with a row of about

seven small teeth along the dorsal edge. Scutum with general conformation and characteristics of the genus; posterior margin more or less three sided. Sensillary bases about on a line with the posterolateral setae. Bases of sensillae with a small number of very small barbs; sensillae nude distally. With 80 or more dorsal setae, more or less scattered. A single pair of sternal



Fig. 2 *Gahrlepiea ogatai*

S. 36-62-2

setae between coxae III. Coxal setae 2-1-1. Scutal measurements of holotype: AW-66, PW-76.5, SB-24, ASB-27, PSB-20, SD-47.5, AP-24, AM-46, AL-46, PL-64, S-72.



Fig. 3 *Gahrliepia saduski*

DISTRIBUTION AND HOSTS: Known only from the type collection.

TYPE DATA: From *Rattus rattus* from Miyake Island (Izu Islands, south of Tokyo), January 18, 1952; holotype and one paratype deposited at the Kitasato Institute, Tokyo.

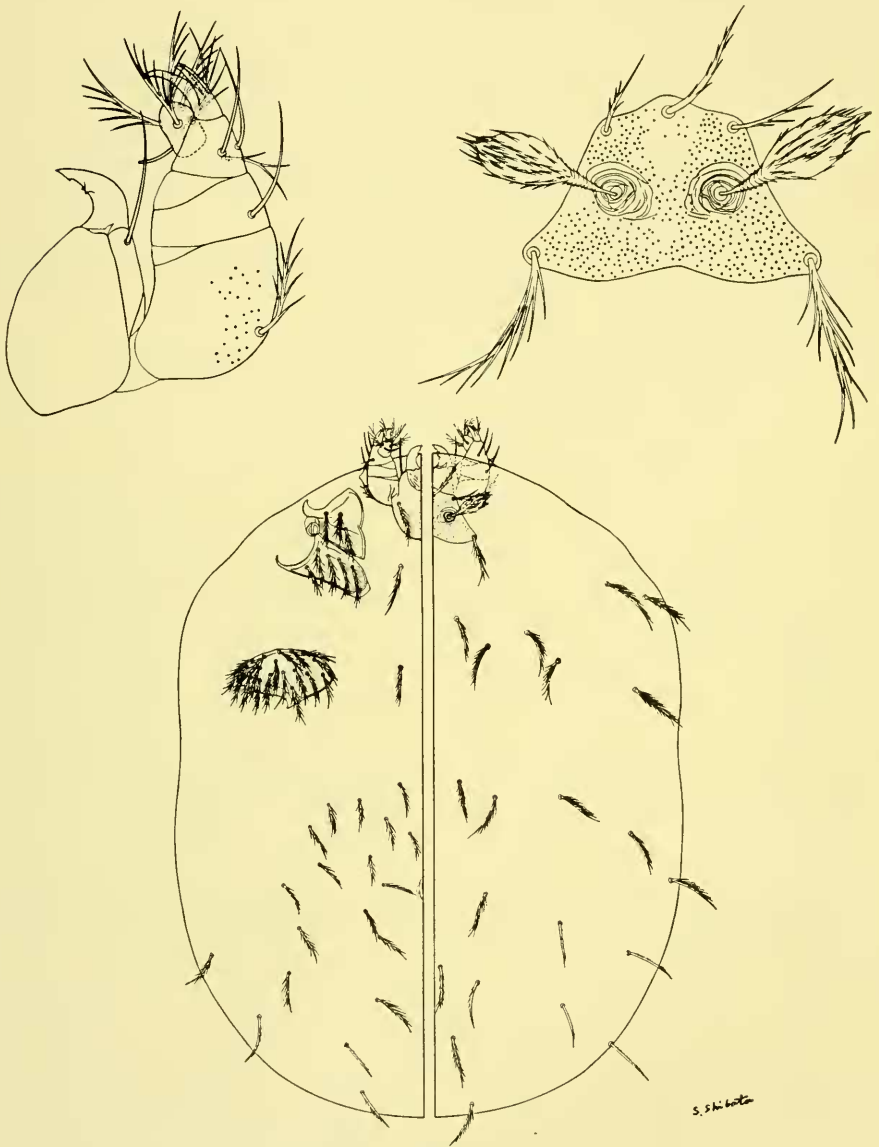


Fig. 4 *Doloisia okabei*

Gahrlepieia (Walchia) ogatai (Sasa and Teramura, 1951)
(Figure 2)

Walchia ogatai SASA and TERAMURA, 1951, Tokyo Iji Shinshi, vol. 68, no. 5, pp. 9-10.

DIAGNOSIS: Galeal seta forked (not nude as in the original description); palpal setae all forked or feathered except lateral tibial seta which is nude. Scutum small, bluntly or sharply pointed posteriorly. Two pairs of humeral setae. Coxal setae 1-1-4 or 5. Sternal setae 2-2. Scutal measurements of holotype: AW-34, PW-57, SB-27, ASB-26, PSB-27, AP-36, AL-31, PL-30, S-28.

DISTRIBUTION AND HOSTS: *Mogera wogura* and *Apodemus speciosus* from Akita and Shizuoka prefectures.

TYPE DATA: Holotype and four paratypes taken from *Mogera wogura*, Uchitomo, Akita Prefecture; November 3, 1950. Deposited at the Institute for Infectious Diseases, University of Tokyo.

Gahrlepieia (Gahrlepieia) saduski Womersley, 1952
(Figure 3)

Gahrlepieia (Gahrlepieia) saduski WOMERSLEY, 1952, Records of the South Australia Museum, vol. 10, pp. 301-302.

DIAGNOSIS: Galeal seta feathered; palpal setae feathered, except dorsal and lateral tibial setae which are nude. Scutum unsculptured and with no punctae; with 2-5 setae behind PL. Coxal setae 1-1-3, 4, or 5 (some specimens have 3 setae on coxa III on one side and 5 on the opposite side). Scutal measurements (mean of seven specimens given by the describer): AW-48.9, PW-63.5, SB-41.4, ASB-22.4, PSB-65.4, SD-87.8, AP-38.4, AL-36.7, PL-35.2, S-38.4.

DISTRIBUTION AND HOSTS: Known from many localities in Honshu, Shikoku, and Kyushu; from *Mus. sp.*, *Apodemus speciosus*, *A. geisha*, *Clethrionomys smithii*, *Microtus montebelloi*, *Urotrichus talpoides*, and *Passer montanus*.

TYPE DATA: Holotype and two paratypes from *Mus. sp.*, Misinobe (probably a misspelling of Mizonobe) near Yachi, Yamagata Prefecture; October 28, 1945. Holotype at South Australia Museum, Adelaide.

Doloisia okabei Sasa *et al.*, 1952
(Figure 4)

Doloisia okabei SASA, HAYASHI, KAWASHIMA, MITSUTOMI, and EGASHIRA, 1952, Tokyo Iji Shinshi, vol. 69, no. 3, p. 12.

DIAGNOSIS: The only species of the genus known from Japan. Coxal setae 2-4(4-5)-8(7-9). Sternal setae 2-2. Galeal seta nude. Palpal

femoral seta feathered; palpal genual and dorsal and lateral palpal tibial setae nude; ventral tibial seta feathered. Palpal claw three-pronged. Scutal measurements of holotype: AW-28, PW-63, SB-23, ASB-23, PSB-20, AP-30, AM-30, AL-21, PL-40, S-35.

DISTRIBUTION AND HOSTS: Known only from the original collection.

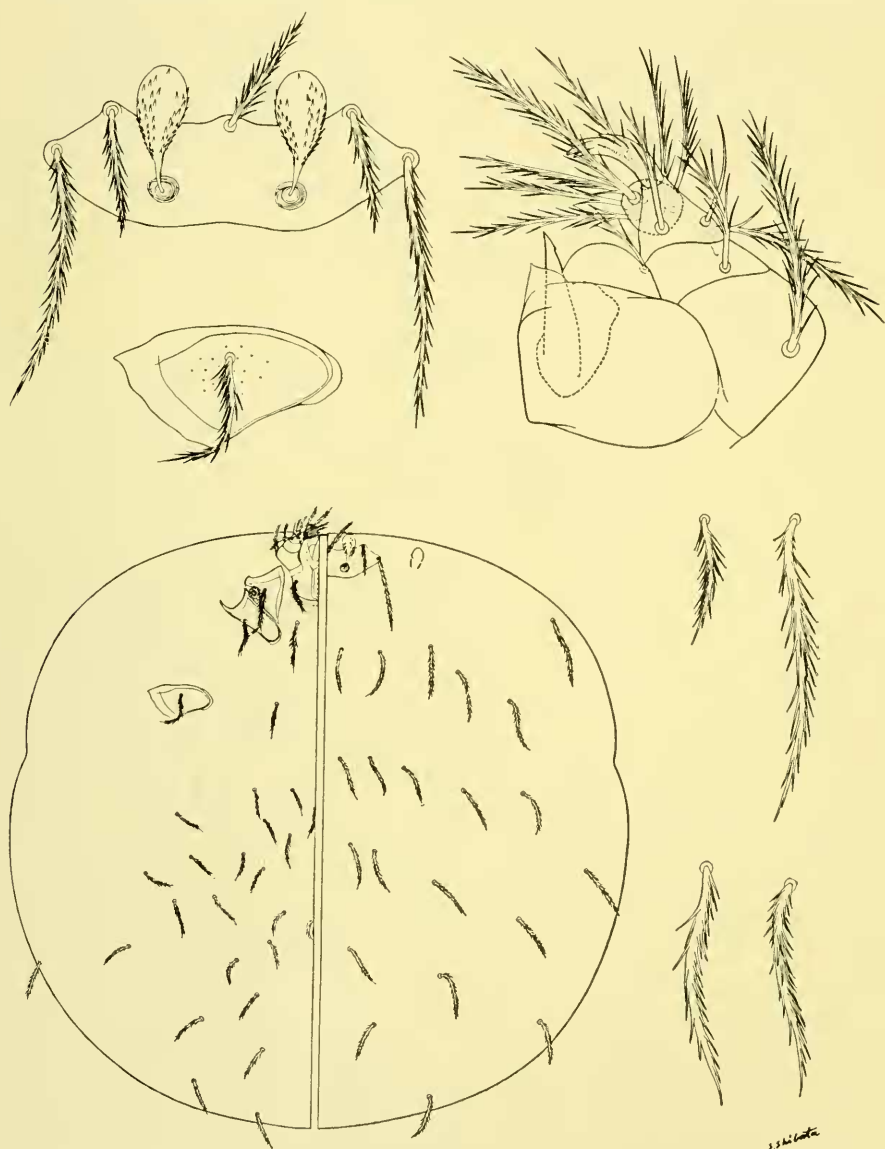


Fig. 5 *Euschöngastia alpina*

TYPE DATA: Holotype and two paratypes from *Urotrichus talpoides*, taken at Toshita, Kumamoto Prefecture; October 21, 1951. Holotype and two paratypes deposited at the Institute for Infectious Diseases, University of Tokyo.



Fig. 6 *Euschöngastia ikaoensis*

Genus **Euschöngastia** Ewing, 1938

Only four species of *Euschöngastia* are known from Japan and they are relatively uncommon. To date only one species (*E. ikaoensis*) is known to

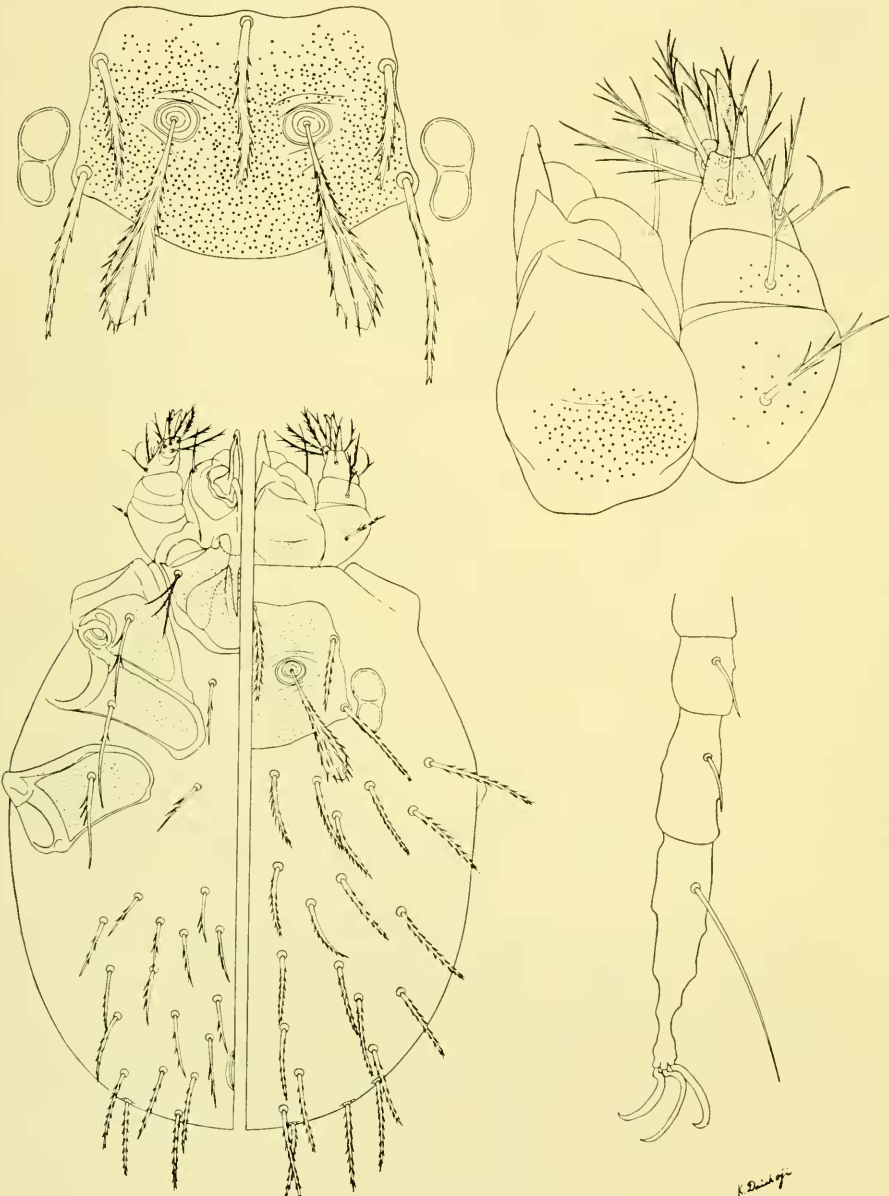


Fig. 7 *Euschöngastia kitajimai*

occur on the adjacent Asiatic mainland; this species has been taken in southern Korea. *Euschöngastia* differs from *Neoschöngastia* in the character of the scutum and in the host distribution: in *Euschöngastia* the scutum lies entirely on the surface of the integument and the hosts are mammals, whereas in *Neoschöngastia* at least some parts of the scutum lie beneath euticular striae and the hosts are almost always birds.

KEY TO JAPANESE SPECIES OF EUSCHÖNGASTIA

1. No mastitarsalae III..... 2
- One mastitarsala III..... *E. kitajimai*
2. A single seta on coxa III..... 3
- Two setae on coxa III..... *E. miyagawai*
3. Two pairs of humeral setae; lateral tibial seta of palpus feathered; galeal seta nude..... *E. ikaoensis*
- A single pair of humeral setae; lateral tibial seta of palpus nude; galeal seta branched..... *E. alpina*

***Euschöngastia alpina* Sasa and Jameson, new species**

(Figure 5)

GNATHOSOMA: Chelicera with a subapical dorsal tooth; cheliceral base with no punctae. Capitular sternum with a single feathered seta and a few punctae. Palpal genual and femoral setae feathered; dorsal and ventral tibial setae feathered, lateral seta nude. Palpal claw five-pronged. Galeal seta branched.

LEGS: All coxae unisetose; the seta on coxa III distinctly behind the anterior margin of the coxa. Specialized (nude) setae: Leg I, 2 genulae, 1 microgenuala, 2 tibialae, 1 microtibiala, 1 spur, 1 microspur, 1 subterminala, 1 parasubterminala, 1 pretarsala; Leg II, 1 genuala, 2 tibialae, 1 spur, 1 microspur, and 1 pretarsala; Leg III, 1 genuala.

SCUTUM: Broadly rectangular, more than three times as wide as long, eoneave anteriorly, convex posteriorly, and with the lateral margins diverging posteriorly. Posterior corners angular, posterolateral setae placed in the corners. Sensillary bases behind a line connecting posterolateral setae. Sensillae pyriform. Scutum with few or no punctae. No diagonal lines in front of sensillary bases. Scutal measurements of holotype: AW-63, PW-95, SB-36, ASB-26, PSB-9, AP-20, AM-35, AL-35, PL-75, S-40.

SETAE: Humeral setae similar to posterolateral setae; other dorsal setae slightly shorter. Dorsal setal formula 2-10-12-8-6-2-2. Sternal setae 2-2. About 44 small setae ventrally behind coxae III.

TYPE: Holotype from *Apodemus geisha*, Kamikoechi (1600 meters, elevation), Nagano Prefecture; July 12, 1952. One paratype from *A. speciosus*, Mt. Hiei, Shiga Prefecture; March 27, 1952. Both specimens collected by Mitosi Tokuda and E. W. Jameson, Jr. Deposited in the United States National Museum.

***Euschöngastia ikaoensis* (Sasa *et al.*, 1951)**

(Figure 6)

Neoschöngastia ikaoensis SAsA, SAWADA, KANO, HAYASHI, and KUMADA, 1951, Tokyo Iji Shinshi, vol. 68, no. 4, p. 7.

DIAGNOSIS: All palpal setae feathered. Galeal seta nude. Palpal elaw 5-7 pronged. Sternal setae 2-2. Coxal setae 1-1-1. Bases of sensillae about as far from each other as from their adjacent lateral margins of the scutum; sensillae pyriform. Two pairs of humeral setae. Scutal measurements of holotype: AW-61.5, PW-67, SB-24, ASB-18, PSB-15.5, AP-21, AM-30, AL-30, PL-39, S-33.

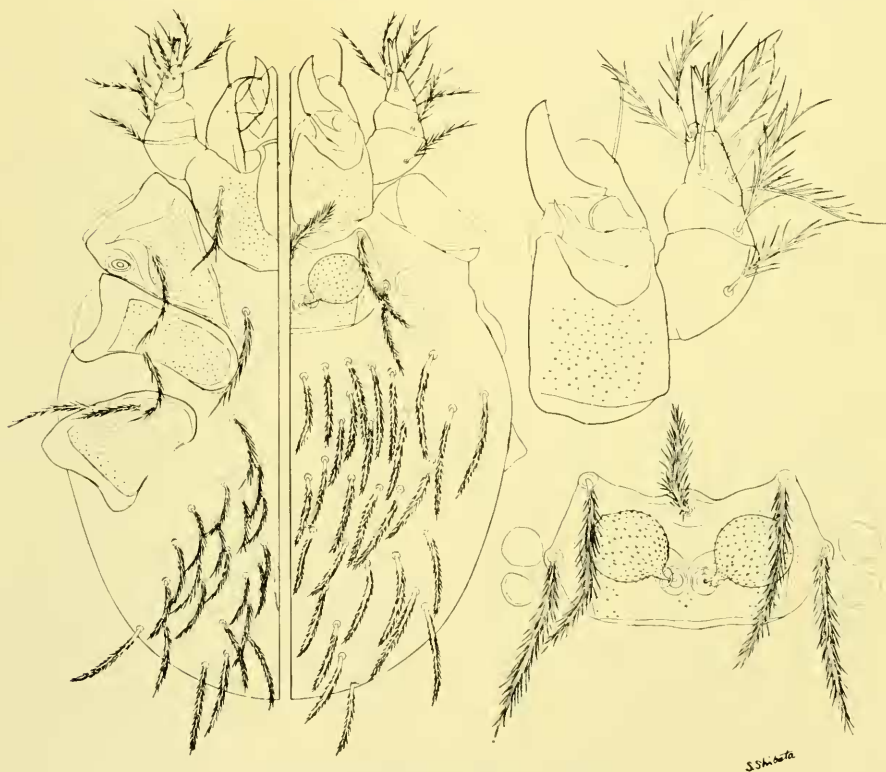


Fig. 8 *Euschöngastia miyagawai*

DISTRIBUTION AND HOSTS: From Kanagawa, Gumma, Oita, Yamanashi, Shizuoka, Kumamoto, and Shimane prefectures from *Urotrichus talpoides*, *Apodemus speciosus*, *Clethrionomys smithii* and *Mus molossinus*; this chigger also occurs in southern Korea.

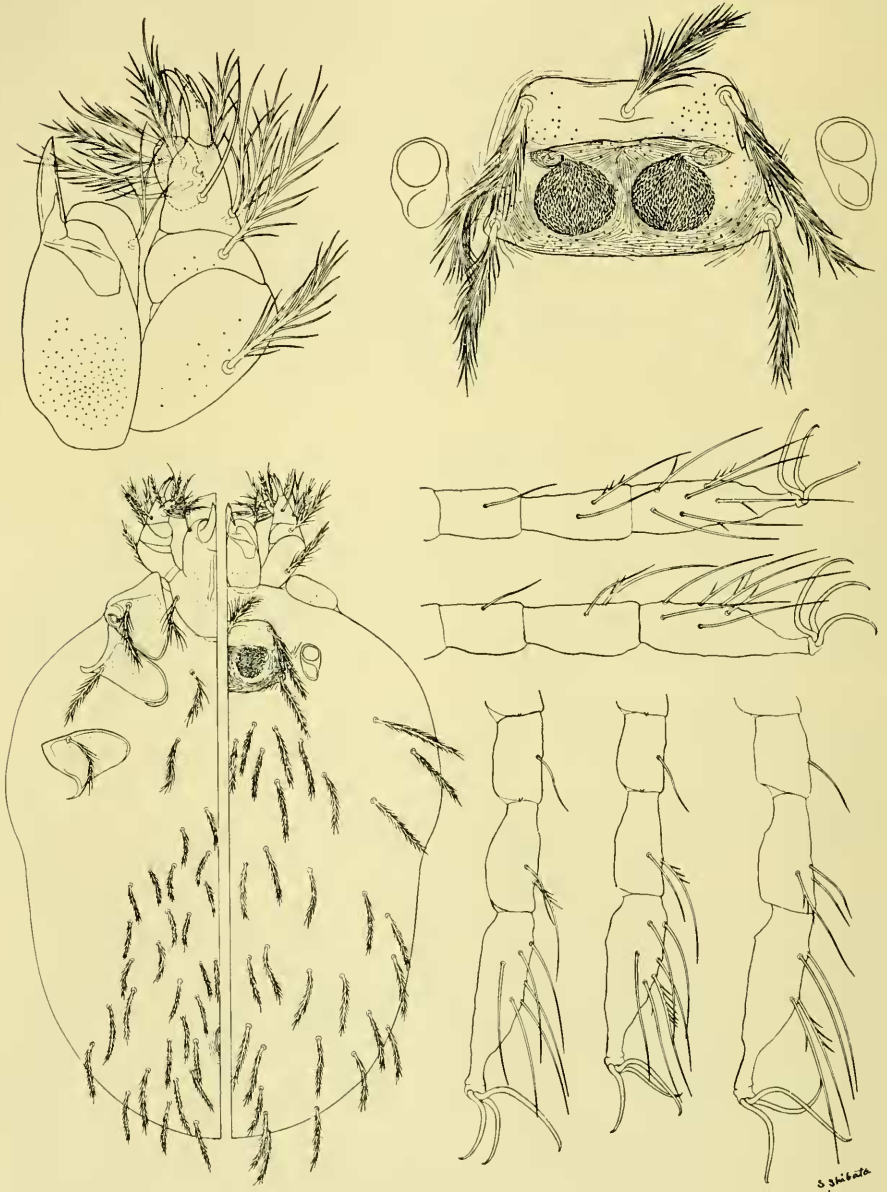


Fig. 9 *Neoschöngastia asakawai*

TYPE DATA: Holotype from *Apodemus speciosus* from Ikao, Gumma Prefecture; November 27, 1950. Two paratypes from the same host from Yamanaka, Yamanashi Prefecture; November 22, 1950. Holotype and paratypes deposited at Institute for Infectious Diseases, University of Tokyo.

***Euschöngastia kitajimai* Fukuzuki and Obata, 1953**

(Figure 7)

Euschöngastia kitajimai FUKUZUKI and OBATA, 1953, Kitasato Archives of Experimental Medicine, vol. 26, no. 1, pp. 1-22.

DIAGNOSIS: Palpal femoral seta feathered; palpal genual seta and palpal tibial setae feathered or branched. Galeal seta nude. Palpal claw three-pronged. Sensillary bases closer to their adjacent scutal margins than to each other, midway between anterolateral and posterolateral setae. Sen-

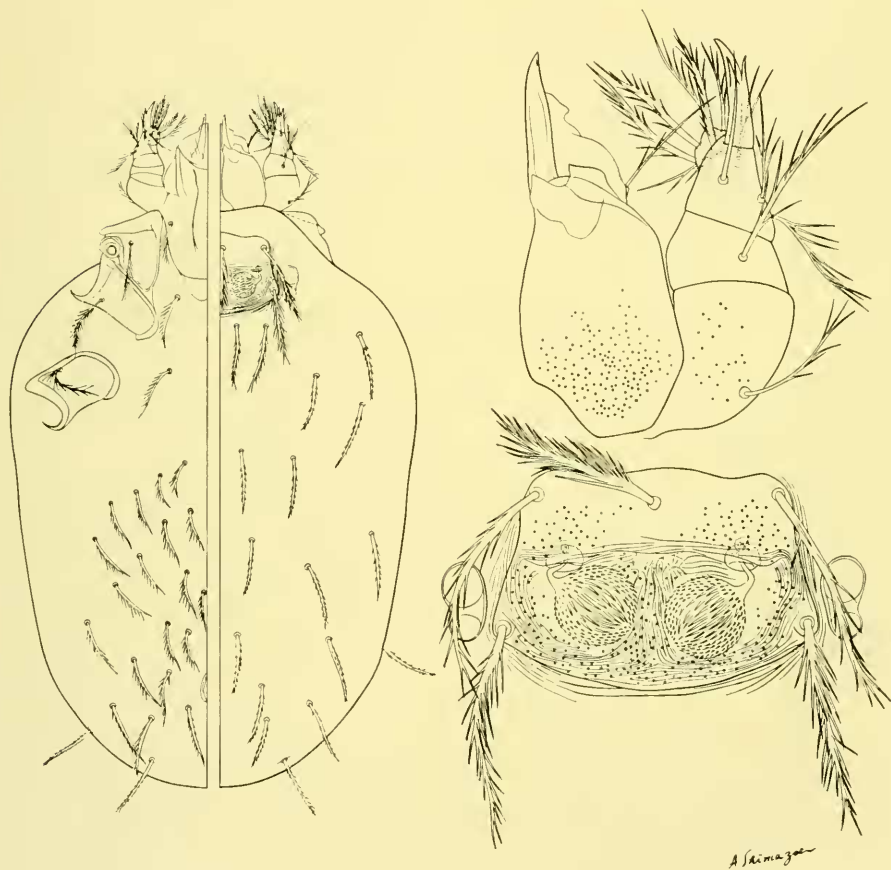


Fig. 10 *Neoschöngastia posekanyi*

sillae about five times as long as wide, with several rows of long barbs. Sternal setae 2-2. Coxal setae 1-1-1. One mastitarsala III. Scutal measurements of holotype: AW-52, PW-62.5, SB-24, ASB-22.5, PSB-26, AP-33, AM-31, AL-25, PL-36, S-37.

DISTRIBUTION AND HOSTS: Known only from the original collection.

TYPE DATA: From *Rattus rattus*, Miyake Island (Islands of Izu, south of Tokyo); January 18, 1952; deposited at Kitasato Institute, Tokyo.

***Euschöngastia miyagawai* Sasa *et al.*, 1951**

(Figure 8)

Euschöngastia miyagawai SASA, KUMADA, and MIURA, 1951, Tokyo Iji Shinshi, vol. 68, no. 8, p. 19.

?*Neoschöngastia covelli* RADFORD, 1953. Parasitology, vol. 42, nos. 3 and 4, pp. 233-235.

DIAGNOSIS: Palpal genual and femoral setae feathered; dorsal tibial seta branched or nude, lateral tibial seta branched, and ventral tibial seta feathered. Galeal seta nude. Palpal claw 3-5 pronged. Sensillary bases very close together; sensillae globular. Sternal setae 2-2. Coxal setae 1-1-2. Dorsal setae in indistinct rows, between 50 and 60 setae. Scutal measurements of holotype: AW-62, PW-81, SB-8, ASB-28, PSB-11, AP-26, AM-40, AL-61, PL-57, S-31.

DISTRIBUTION AND HOSTS: Known from *Apodemus speciosus* and *Mustela* sp. and several kinds of wild birds from Kanagawa, Yamanashi, and Kofu prefectures, and from Miyake Island, south of Tokyo.

TYPE DATA: Holotype and two paratypes from *Apodemus speciosus* from Okuyugawara, Kanagawa Prefecture; March 5, 1951; deposited at the Institute for Infectious Diseases, University of Tokyo.

REMARKS: The original illustration is in error in showing the seta on the first palpal segment (palpal coxal seta) nude; this seta is feathered. *Neoschöngastia covelli* Radford, 1953 closely resembles *E. miyagawai* and may well be a synonym. *N. covelli* was described from a squirrel (*Callosciurus pygerythrus*) from Imphal, Manipur State, India.

Genus ***Neoschöngastia*** Ewing, 1929

In Japan there are six species of *Neoschöngastia*, all parasites of birds; undoubtedly additional species will be found in the future. The condition of the palpal setae, galeal seta, number of prongs on the palpal claw, presence or absence of mastitarsalae III, number of setae on coxa III, and the number of sternal setae are all variable in this genus, and are specific characters. The almost unique feature of *Neoschöngastia* is the position of the

scutum, being partly submerged beneath the integument so that the cuticular striae can be seen above the scutum.

KEY TO JAPANESE SPECIES OF NEOSCHÖNGASTIA

1. Coxa III with more than a single seta.....	2
— Coxa III with a single seta.....	3
2. Fifteen or more sternal setae.....	<i>N. carveri</i>
— Two pairs of sternal setae.....	<i>N. americana solomonis</i>
3. Sternal setae 2-2-2.....	<i>N. paenitans</i>
— Sternal setae 2-2.....	4
4. Sensillae spatulate, with long, slender scales.....	<i>N. monticola</i>
— Sensillae globular, with short scales.....	5
5. One mastitarsala III.....	<i>N. posekanyi</i>
— Two to six mastitarsalae III.....	<i>N. asakawai</i>

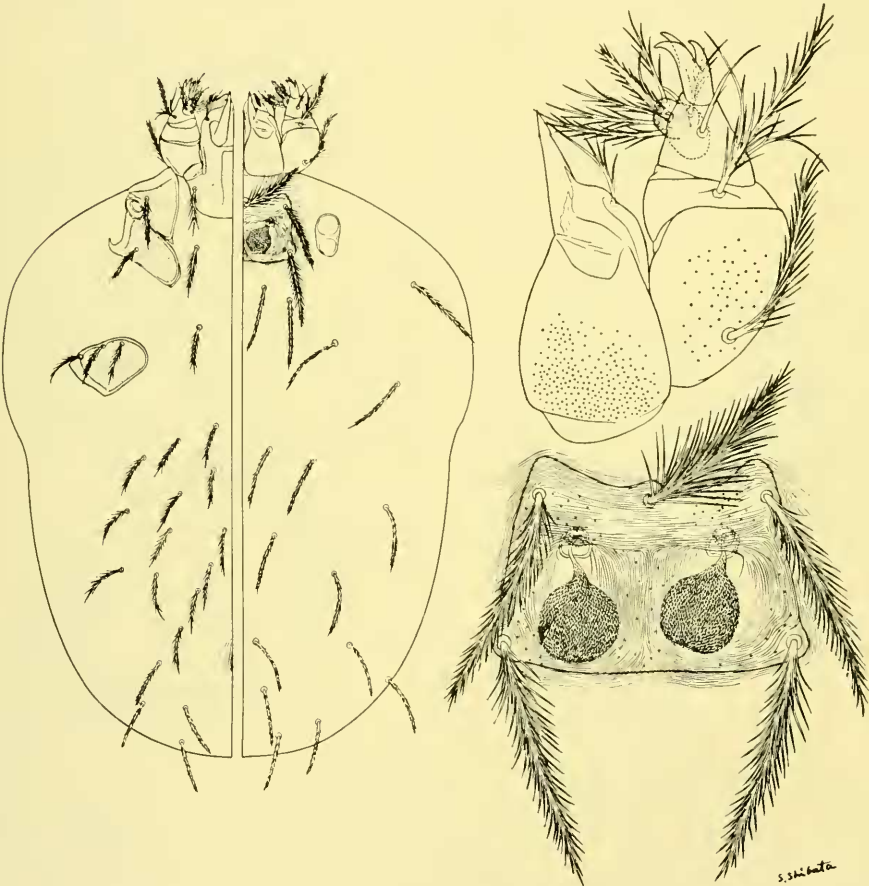


Fig. 11 *Neoschöngastia americana*

Neoschöngastia asakawai Fukuzumi and Obata, 1953

(Figure 9)

Neoschöngastia asakawai FUKUZUMI and OBATA, 1953, Kitasato Archives of Experimental Medicine, vol. 26, no. 1, pp. 1-22.

DIAGNOSIS: This species bears some resemblance to *N. posekanyi*, but is distinguished by the greater number of mastitarsalae III and two or three pairs of humeral setae. In *N. asakawai* there are many more dorsal setae than in *N. posekanyi*. The variation in the number of mastitarsalae III (Fig. 9) is quite uncommon in *Neoschöngastia*; these nude setae numbered from two to six. Scutal measurements of holotype: AW-50, PW-68, SB-41.5, ASB-22.5, PSB-30, SD-50.5, AP-40, AM-41.5, AL-51, PL-46, S-26.5.

DISTRIBUTION AND HOSTS: Collected from birds (*Scolopax rusticola*, *Bambusicola thoracica*, *Siphia mugimaki*, *Prunella rubida*, *Emberiza clioides*,



Fig. 12 *Neoschöngastia paenitens*

E. spodecephala, *Turdus obscurus*, and *Passer montanus*); known from Miyake Island (Tokyo-to) and Yamanashi Prefecture.

TYPE DATA: Holotype from *Scolopax rusticola*, Miyake Island (Islands of Izu, south of Tokyo); January 20, 1952; deposited at Kitasato Institute, Tokyo.

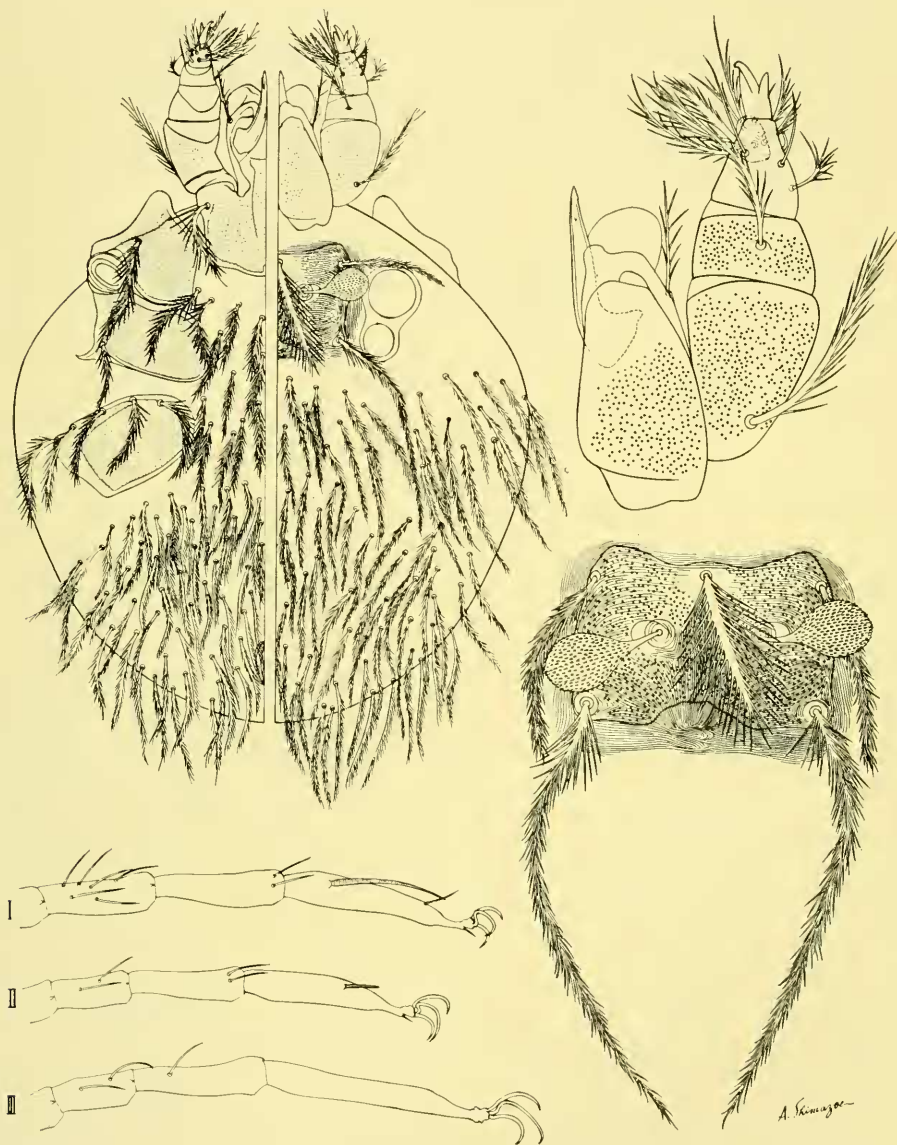


Fig. 13 *Neoschöngastia carveri*

Neoschöngastia posekanyi Wharton and Hardeastle, 1946

(Figure 10)

Neoschöngastia posekanyi WHARTON and HARDEASTLE, 1946, Journal of Parasitology, vol. 32, p. 302.

DIAGNOSIS: Head of sensillae globular, with small scales. Coxae unisetose. Sternal setae 2-2. One mastitarsala III. One pair of humeral setae. Galeal seta nude (in original description) or 2-3 forked (in Japanese specimens). Palpal femoral and genual setae branched; dorsal tibial seta nude; lateral tibial seta forked; and ventral tibial seta feathered. Scutal measurements (mean of five specimens) given by the describers: "AW-75, PW-80, SB-47, ASB-25, PSB-34, AP-29, AM-49, AL-73, PL-52, S-30."

DISTRIBUTION AND HOSTS: Collected from birds (*Turdus celanops*, *Monticola solitarius*, *Streptopelia orientalis*, and *Columba janthina*) from Hachijo and Koshima islands, south of Tokyo; *Saricola torquata* and *Chloris sinica*, Schizuoka Prefecture.

TYPE DATA: Holotype from *Streptopelia orientalis*, Hianza Island, Okinawa. Deposited in the United States National Museum.

Neoschöngastia americana solomonis Wharton and Hardeastle, 1946

(Figure 11)

Neoschöngastia americana solomonis WHARTON and HARDEASTLE, 1946, Journal of Parasitology, vol. 32, p. 289.

DIAGNOSIS: Coxal setae 1-1-3. No mastitarsalae III. Sternal setae 1-1. One pair of humeral setae. Galeal seta branched, and all palpal setae branched or feathered. Palpal claw three-pronged. Sensillary bases far apart; nearer their adjacent scutal margin than to each other. Sensillae globular, with many fine scales. Scutal measurements (mean of five specimens from Okinawa) as given by the describers: "AW-51, PW-70, SB-37, ASB-25, PSB-30, AP-36, AM-44, AL-56, PL-59, S-24." Scutal measurements of a specimen from Japan: AW-50, PW-64, SB-34, ASB-34, PSB-31, AP-36, AM-42, AL-55, PL-52, S-25.

DISTRIBUTION AND HOSTS: From Hachijo Island from *Monticola solitarius*. Originally described from Bougainville, Guam, and Okinawa. *Neoschöngastia a. americana* is known from North America.

TYPE DATA: Collected from *Hirundo tahitica*, Cape Torokina, Bougainville; July 3, 1944. Holotype deposited in the United States National Museum.

REMARKS: In scutal measurements the Japanese specimens resemble *N. a. solomonis* more closely than *N. a. americana*, but the difference (length of the scutum) may well prove to be clinal.

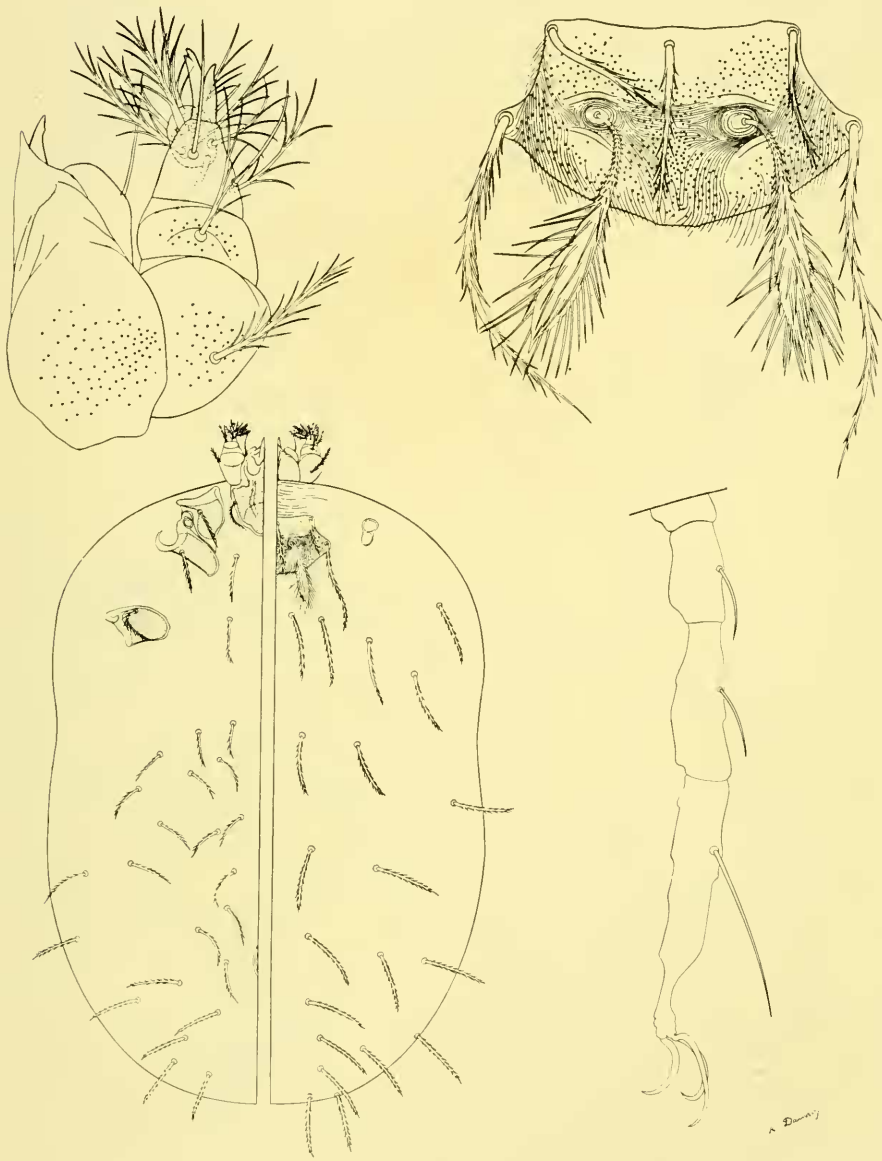


Fig. 14 *Neoschöngastia monticola*

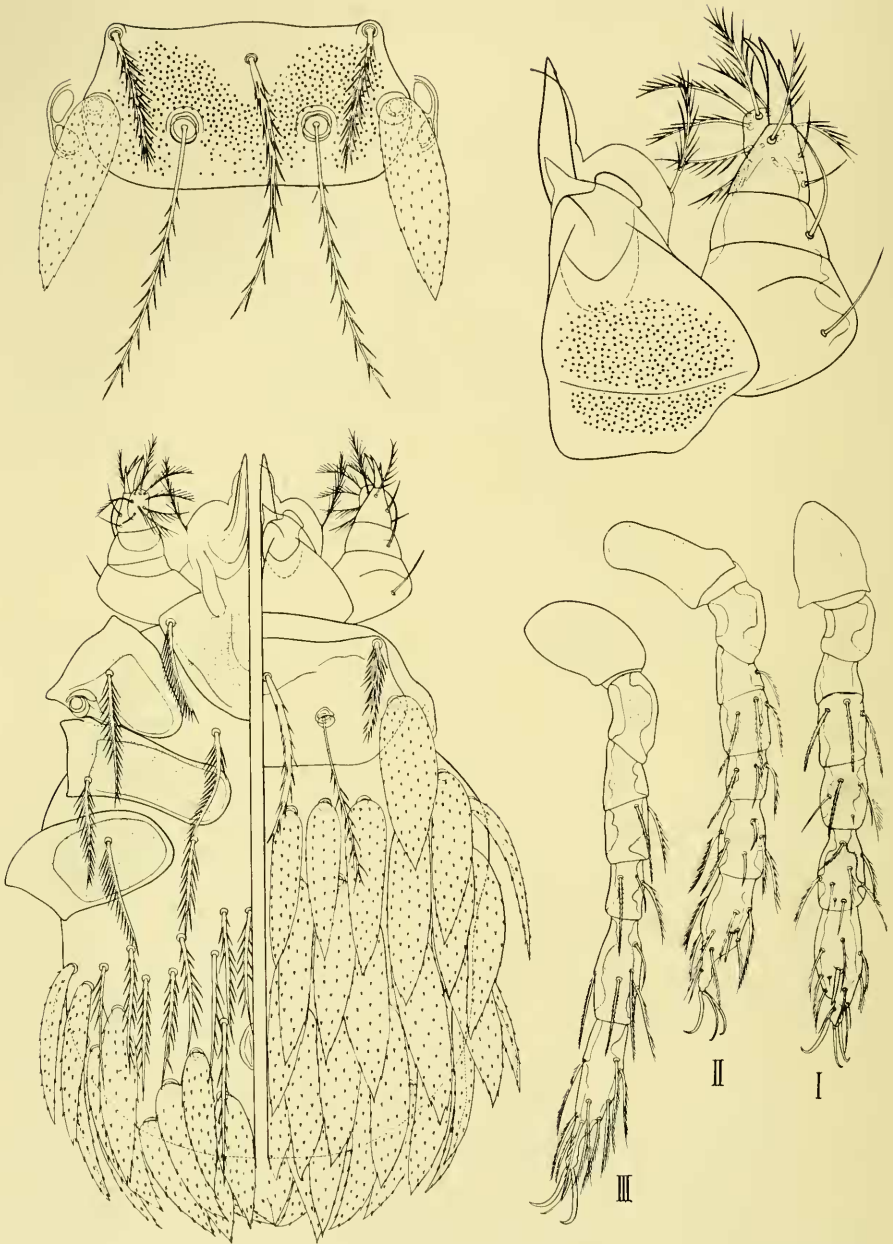


Fig. 15 *Trombicula kansai*



Fig. 16 *Trombicula kochiensis*

Neoschöngastia paenitens Brennan, 1952

(Figure 12)

Neoschöngastia kohlsi BRENNAN, 1951, Journal of Parasitology, vol. 37, no. 579; pre-occupied by *N. kohlsi* Philip and Woodward, 1946.

N. paenitens BRENNAN, 1952, Proceedings Entomological Society of Washington, vol. 54, p. 137.

?*N. okumurai* FUKUZUMI and OBATA, 1953, Kitasato Archives Experimental Medicine, vol. 26, no. 1, pp. 1-22.

DIAGNOSIS: Coxal seta 1-1-1. Two almost nude setae on tarsus III. Femoral, genual, and ventral tibial setae of palpus branched or feathered. Lateral and dorsal tibial setae of palpus nude. Galeal seta nude. Sensillary bases closer to each other than to their respective scutal margins; sensillae globular, with many fine scales. Scutal measurements of holotype (Brennan, 1951: 580): "AW-52, PW-76, SB-25, ASB-25, PSB-20, AP-38, AM-40, AL-54, PL-49, S-31." Scutal measurements of a Japanese specimen: AW-49, PW-71, SB-21, ASB-25, PSB-18, AP-32, AM-31, AL-50, PL-53, S-28.

DISTRIBUTION AND HOSTS: Previously known only from Montana, U.S.A. In Japan known from Aomori Prefecture and Hachijo Island from *Monticola solitarius*.

TYPE DATA: Collected from *Petrochelidon pyrrhonota*, Granite County, Montana; July 17, 1950. Holotype deposited in the United States National Museum.

COMMENT: *N. okumurai* Fukuzumi and Obata seems closely related to *paenitens* and is probably a synonym.

Neoschöngastia carveri Wharton and Hardeastle, 1946

(Figure 13)

Neoschöngastia carveri WHARTON and HARDEASTLE, 1946, Journal of Parasitology, vol. 32, p. 313.

DIAGNOSIS: This species is distinct in the large number of sternal setae (20-24), the numerous setae on coxa III (5-8), the excessively long spur on leg I (more than half as long as the tarsus), and the presence of at least two genualae on each leg. Scutal measurements (mean of five specimens) as given by the describers: "AW-80, PW-84, SB-43, ASB-30, PSB-37, AP-45, AM-71, AL-74, PL-141, S-40." Scutal measurements of a Japanese specimen: AW-83, PW-84, SB-36, ASB-31, PSB-38, AP-46, AM-46, AL-76, PL-120, S-42.

DISTRIBUTION AND HOSTS: Originally described from Guam, Okinawa, Ulithi and Peleliu from numerous birds; in Japan from *Monticola solitarius* from Hachijo Island.

TYPE DATA: Collected from *Demigretta sacra*, Port Ajayan, Guam; July 16, 1945. Deposited in the United States National Museum.



Fig. 17 *Trombicula japonica*



Fig. 18 *Trombicula nagayoi*

***Neoschöngastia monticola* Wharton and Hardeastle, 1946**
(Figure 14)

Neoschöngastia monticola WHARTON and HARDCASTLE, 1946, Journal of Parasitology, vol. 32, p. 301.

DIAGNOSIS: Distinctive in the narrow sensillae which are provided with long hairs. Coxae unisetose. Sternal setae 2-2. One mastitarsala III. One pair of humeral setae. Scutal measurements (mean of five specimens)



Fig. 19 *Trombicula mitamurai*

given by the describers: "AW-56, PW-78, SB-32, ASB-24, PSB-26, AP-27, AM-43, AL-35, PL-75, S-71." Scutal measurements of a Japanese specimen: AW-57, PW-83, SB-34, ASB-25, PSB-28, AP-29, AM-43, PL-36, PL-76, S-70.

DISTRIBUTION AND HOSTS: Originally known only from Okinawa. As stated by the describers, this chigger seems to be confined to birds of the genus *Monticola*. In Japan it occurs on *Monticola solitarius* on Miyake Island and Hachijo Island.

TYPE DATA: From *Monticola solitarius*, Takabannase Island, Okinawa; June 10, 1945. Holotype in the United States National Museum.

Genus *Trombicula* Berlese, 1905

The genus *Trombicula* is based on adult morphology; the larva of the genotype (*Trombicula minor* Berlese) has not yet been associated with the adult, and therefore the current definition of the larval stage of *Trombicula* is tentative, a clarification pending the discovery of the larva of *Trombicula minor*. This interesting situation has been discussed at length by various authors. In *Trombicula* we include those chiggers with seven segments in each leg, the scutum with five setae and a pair of flagelliform sensillae, and in which the empodium is claw-like. There are several subgenera and numerous species that do not fit into any established subgenera.

Subgenus *Trombiculindus* Radford, 1948

Trombiculindus was established as a genus for a chigger in which the posterolateral setae and some of the body setae are expanded and foliate. This is the only distinctive feature of this group, and we consider it as a subgenus in this paper. One species is known from Japan; the other species of *Trombiculindus* are recorded from the tropical Orient.

Trombicula (*Trombiculindus*) *kansai* Jameson and Sasa, 1953

(Figure 15)

Trombicula (*Trombiculindus*) *kansai* JAMESON and SASA, 1953, Journal of Parasitology, vol. 39, pp. 247-249.

DIAGNOSIS: With the foliate posterolateral setae characteristic of the subgenus. Palpal genual, femoral, and lateral and ventral tibial setae nude; dorsal tibial seta feathered. Galeal seta feathered. Sensillary bases slightly behind posterolateral setae; sensillae nude basally, with barbs on the distal two-thirds. Posterolateral setae with small barbs on their surface. Sternal setae 2-2. Coxal setae 1-1-1. Two pairs of humeral setae. All dorsal setae and approximately half of the ventral setae foliate. Scutal measurements

of holotype: AW-70, PW-82, SB-33, ASB-29, PSB-17, AP-20, AM-79, AL-44, PL-58, S-64.

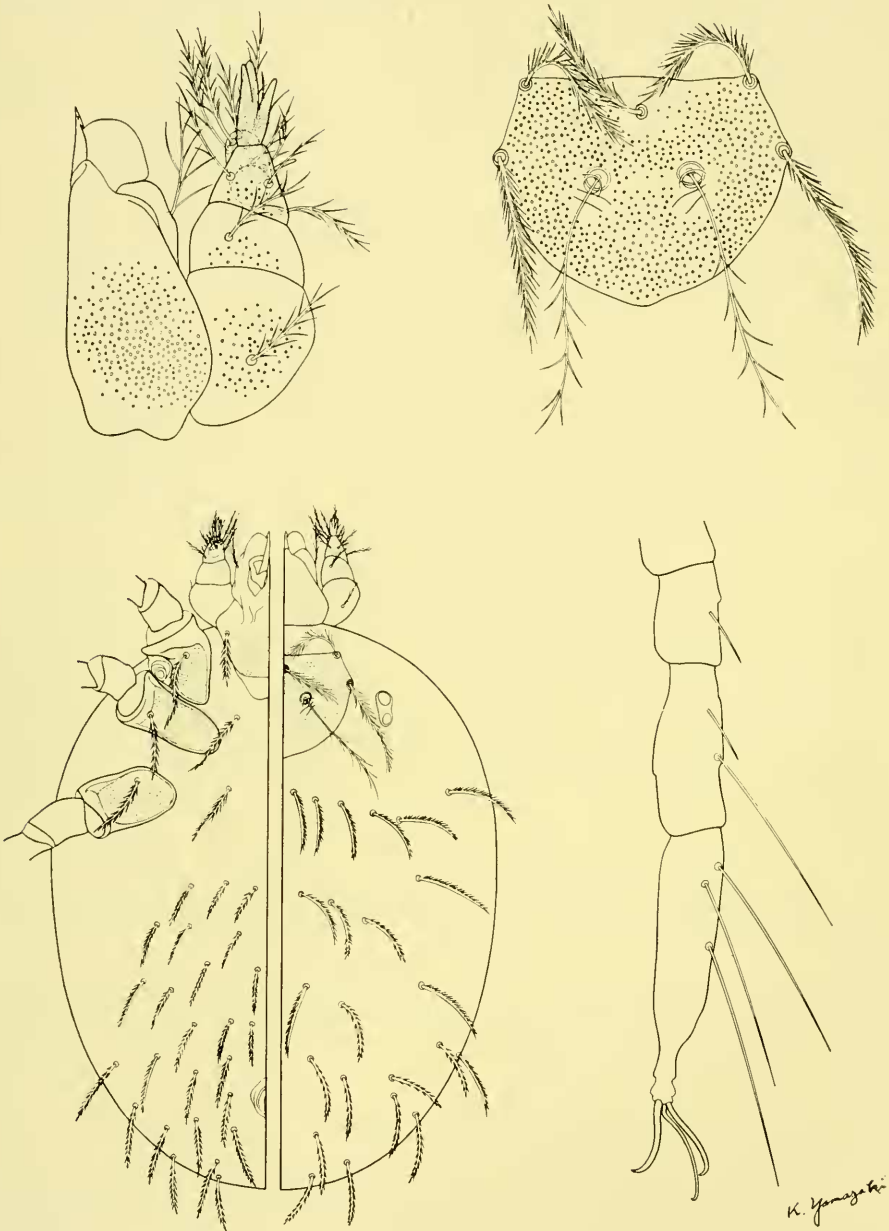


Fig. 20 *Trombicula tamiyai*

DISTRIBUTION AND HOSTS: Most of the specimens were collected from the shrew-mole, *Urotrichus talpoides*; they usually attached at the base of the tail. A few specimens were found on the mice, *Apodemus geisha* and *A. speciosus*. Kyoto, Hyogo, Mie, Shiga, Kumamoto, and Oita prefectures.

TYPE DATA: Holotype from *Urotrichus talpoides*, Ohara Area (near Kyoto City), Kyoto Prefecture; March 8, 1952. Holotype and ten paratypes deposited in the United States National Museum.

Subgenus **Miyatrombicula** Sasa, Kawashima, and Egashira, 1952.

This monotypic subgenus is characterized by the multisetal condition of coxa III, the pentagonal scutum, and the presence of a short mastitarsala III. It appears to be allied to *Trombicula cynos* Ewing of North America, and a comparison of these two species should be made.

***Trombicula* (*Miyatrombicula*) *kochiensis* Sasa *et al.*, 1952**

(Figure 16)

Trombicula (*Miyatrombicula*) *kochiensis* SASA, KAWASHIMA, and EGASHIRA, 1952, Tokyo Iji Shinshi, vol. 27, no. 6, p. 5.

DIAGNOSIS: All palpal setae feathered. Palpal claw three-pronged. Galeal seta feathered. Scutum pentagonal, posterior margin projected and rather pointed. Sensillary bases slightly behind a line connecting posterolateral setae. Bases of sensillae nude; distal half or two-thirds with short barbs. Scutal setae densely plumose. Dorsal setae 80 or more, in poorly defined rows. Sternal setae 2-2. Coxal setae 1-1-6(6-9). One very short mastitarsala III. Scutal measurements of holotype: AW-63.5, PW-76, SB-26.5, ASB-38, PSB-35, SD-73, AP-28, AM-40.5, AL-47.5, PL-58.5, S-84.

DISTRIBUTION AND HOSTS: Kochi, Tottori, Shimane, Kumamoto, Oita and Hyogo prefectures from *Apodemus speciosus*, *Clethrionomys smithii* and *Rattus norvegicus*.

TYPE DATA: From *Rattus norvegicus*, Kochi City Park, Kochi Prefecture; November 14, 1951; collected by F. Kawashima; deposited at the Institute for Infectious Diseases.

Subgenus **Neotrombicula** Hirst, 1925

This group of species is easily recognized by several morphological characters: scutum more or less pentagonal with the posterior margin broadly projected (rounded or bluntly pointed), leg III with at least one mastitarsala, unisetose coxae, and sternal setae 2-2; the palpal claw is

three-pronged, and the lateral prong is usually conspicuously divergent. Brennan and Wharton (1950) recently discussed the North American species of *Neotrombicula*, and separated them into several groups: the “*autumnalis*”, “*bisignata*”, and “*microti*” groups of Brennan and Wharton are



Fig. 21 *Trombicula microti*

all represented in Japan. They are parasitic on a variety of small mammals and seem to have no well developed host specificities. Of the six species of the subgenus *Neotrombicula* known from Japan, five (*T. (N.) tamiyai*, *T. (N.) pomeranzevi*, *T. (N.) microti*, *T. (N.) nagayoi*, and *T. (N.) japonica*) also occur on the adjacent Asiatic mainland, and two (*T. (N.) pomeranzevi* and *T. (N.) microti*) are known to occur in North America.

KEY TO JAPANESE SPECIES OF NEOTROMBICULA

- 1. One mastitarsala III (“*autumnalis*” group)..... 2
- One mastitibiala III and two or three mastitarsalae III..... 3
- 2. Sensillary bases in advance of posterolateral setae; usually one pair of humeral setae.....*T. (N.) nagayoi*
- Sensillary bases on a line with posterolateral setae; usually two pairs of humeral setae.....*T. (N.) japonica*
- 3. One mastifemorala III, one mastitibiala III, and two mastitarsalae III (“*microti*” group)..... 4
- No mastifemorala III, one mastitibiala III, and three mastitarsalae III (“*bisignata*” group)..... 5
- 4. More than 50 dorsal setae; palpal genual and femoral setae feathered.....
.....*T. (N.) pomeranzevi*
- Fewer than 30 dorsal setae; palpal genual and femoral setae nude.....
.....*T. (N.) microti*
- 5. Sensillae branched on middle third only; coxa III oval.....*T. (N.) mitamurai*
- Sensillae branched on distal two-thirds; coxa III elongate.....*T. (N.) tamiyai*

***Trombicula (Neotrombicula) japonica* Tanaka *et al.*, 1930**
(Figure 17)

Trombicula autumnalis japonica TANAKA, KAIWA, TERAMURA, and KAGAYA, 1930,
Zentralblatt Bakteriologie, Abt. 1, Band 116, p. 353.

DIAGNOSIS: Galeal seta usually nude, sometimes forked. Palpal femoral, genual, and ventral tibial setae feathered; lateral tibial seta forked or nude; dorsal tibial seta nude. Basal third of sensillae nude; distal two-thirds with moderate branches. Sensillary bases approximately on a line with posterolateral setae. Usually two pairs of humeral setae. Dorsal setae rather long, with short barbs. Scutal measurements of a topotype: AW-81.5, PW-100, SB-34, ASB-37.5, PSB-24, AP-31, AM-70, AP-67.5, PL-82.5, S-80.0 (sensillae measured on a different, but topotypical specimen).

DISTRIBUTION AND HOSTS: Known from Akita, Niigata, Yamagata, Yamaguchi, Ishikari, Nagano, Kyoto, Kumamoto, and Oita prefectures; collected

from *Apodemus geisha* A. *speciosus*, *Clethrionomys rufocanus*, and *Microtus montebelloi*. Known also from southern Korea.

TYPE DATA: Described from *Microtus montebelloi* (?) taken at Yuzawa, Akita Prefecture.

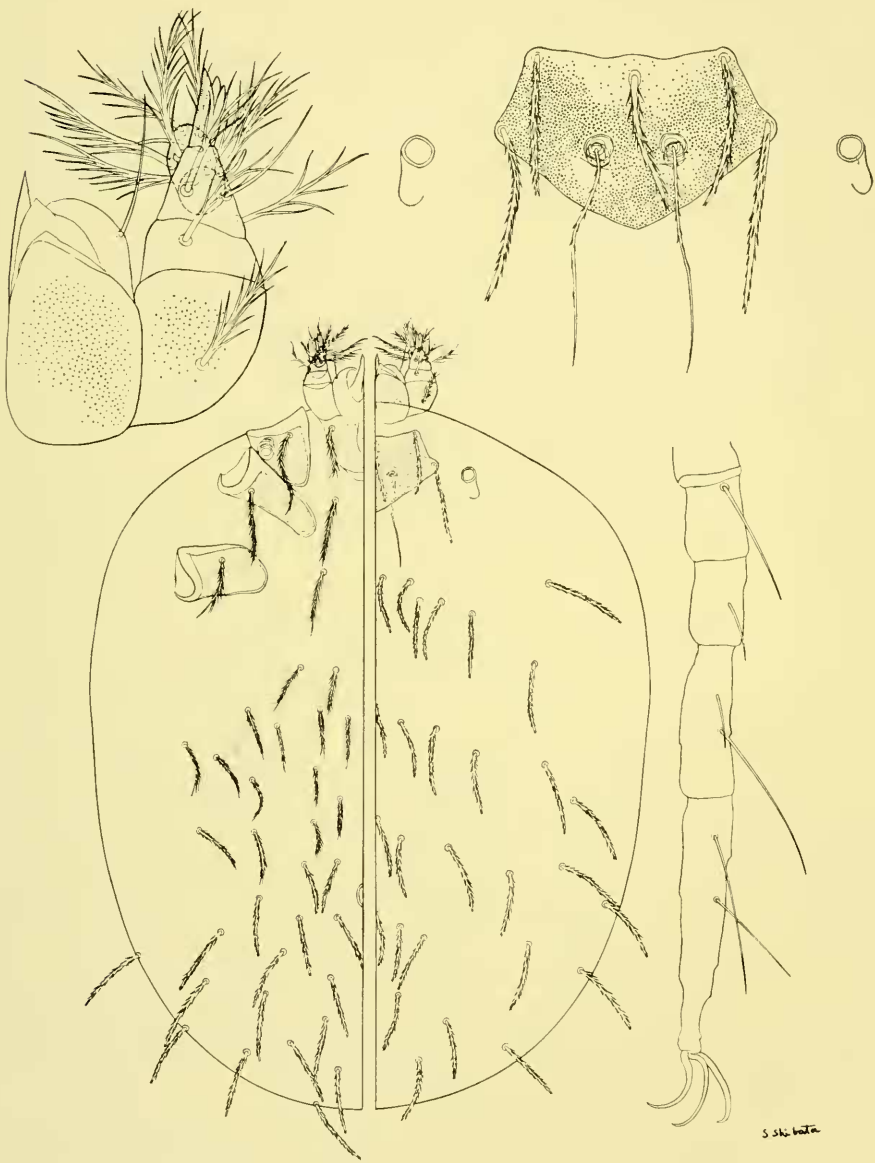


Fig. 22 *Trombicula pomeranzevi*

Trombicula (Neotrombicula) nagayoi Sasa *et al.*, 1950

(Figure 18)

Trombicula nagayoi SASA, HAYASHI, SATO, MIURA, and ASAHINA, 1950, Tokyo Iji Shinshi, vol. 67, no. 12, p. 14.

DIAGNOSIS: The gnathosomal features of *T. nagayoi* are similar to those of *T. japonica*, but generally there are fewer branches on the setae. Palpal femoral seta feathered; palpal genual seta and ventral tibial seta branched; dorsal and lateral tibial setae nude. Galeal seta nude. Sensillary bases distinctly forward of the posterolateral setae. One pair of humeral setae. Dorsal setae shorter than in *T. japonica* and with more barbs. Of the three scuta illustrated (fig. 18), the uppermost is from a paratype slide; the lower two scuta were from a collection in which the scuta were slightly larger and in 12 of 24 specimens bore supernumerary scutal setae. Such aberrations are not infrequent and *T. nagayoi* is especially variable in this respect. Scutal measurements of holotype: AW-72, PW-89, SB-30, ASB-27, PSB-29, AP-31, AM-45, AL-41, PL-57, S-75.

DISTRIBUTION AND HOSTS: Yamanashi, Iburi, Kyoto, and Eniwa prefectures from *Apodemus speciosus*, *Clethrionomys rufocanus*, and *Microtus montebelloi*. Known also from southern Korea.

TYPE DATA: From *Apodemus speciosus*, Yamanaka, Yamanashi Prefecture. Deposited at Institute for Infectious Diseases, University of Tokyo.

Trombicula (Neotrombicula) mitamurai Sasa *et al.*, 1950

(Figure 19)

Trombicula mitamurai SASA, HAYASHI, KUMADA, and TERAMURA, 1950, Tokyo Iji Shinshi, vol. 67, no. 11, p. 18.

DIAGNOSIS: All palpal setae branched or feathered. Galeal seta feathered. Cheliceral base and segments of palpi dorsally with small punctae. Sensillary bases behind posterolateral setae. Sensillae nude basally and distally, with 4-6 branches along middle third. With one or two pairs of humeral setae. Coxa II shaped as illustrated, distinctly more oval than that of *T. tamiyai*. Scutal measurements of holotype: AW-59, PW-84.5, SB-26, ASB-31, PSB-29, AP-26, AM-48, AL-54.5, PL-58, S-81.

DISTRIBUTION AND HOSTS: This species is known from Kanagawa, Shizuoka, Oita, and Yamanashi prefectures from *Urotrichus talpoides*, *Apodemus speciosus*, and *Microtus montebelloi*.

TYPE DATA: Holotype and one paratype from *Urotrichus talpoides* at Yamanaka (slope of Mt. Fuji), Yamanashi Prefecture; deposited at the Institute for Infectious Diseases, University of Tokyo.

Trombicula (Neotrombicula) tamiyai Philip and Fuller, 1950
(Figure 20)

Trombicula tamiyai PHILIP and FULLER, 1950, Parasitology, vol. 40, p. 51.

DIAGNOSIS: Generally quite similar to *T. mitamurai* Sasa *et al.*, but with the distal half or two-thirds of the sensillae with eight or more branches.



Fig. 23 *Trombicula palpalis*

Coxa III more elongate than in *T. mitamurai*. Scutal measurements of type series as given by describers: "AW-65.5, PW-80, SB-25.6, ASB-28.8, PSB-30, AP-19.2, AM-48, AL-42.5, PL-60.8, S-73.6."

DISTRIBUTION AND HOSTS: Yamagata, Niigata, and Akita prefectures; from *Microtus montebelloi*. Known also from southern Korea, from a variety of small rodent hosts.

TYPE DATA: Holotype from *Microtus montebelloi* from Okiage Village, Yamagata Prefecture; September 17, 1920. Type in the United States National Museum.

***Trombicula (Neotrombicula) microti* Ewing, 1928**

(Figure 21)

Trombicula microti EWING, 1928, Proceedings of the Entomological Society of Washington, vol. 30, pp. 77-80.

DIAGNOSIS: Similar in some respects to *T. pomeranzevi* Schluger, especially in the vestiture of the legs. Palpal genual and femoral setae nude; dorsal seta on palpal tibia branched, lateral seta nude, and ventral seta branched. Galeal seta branched or feathered. Sensillary bases slightly in front of posterolateral setae; sensillae with scattered barbs along most of their lengths. Twenty-four to twenty-six dorsal setae in Japanese specimens. Scutal measurements of a specimen from Honshu: AW-47, PW-90, SB-28, ASB-33, PSB-28, AP-32, AM-46, AL-52, PL-56, S-84. Japanese specimens differ from North American specimens chiefly in the distribution of barbs along the sensillae.

DISTRIBUTION AND HOSTS: In Japan this species has been collected from Aomori Prefecture on Honshu and Daisetsu, Hokkaido. Known from many kinds of small rodents and insectivores from many localities in the United States and Canada. Dr. Kiyoshi Asanuma has collected this species from eastern Manchuria.

TYPE DATA: Type from *Microtus richardsoni*, Lincoln County, Wyoming, U. S. A.; August 13, 1927; deposited in the United States National Museum.

***Trombicula (Neotrombicula) pomeranzevi* Schluger, 1948**

(Figure 22)

Trombicula pomeranzevi SCHLUGER, 1948, Entomologicheskoe Obozrenie, (Moscow), tome 30, p. 157.

Trombicula alaskensis BRENNAN and WHARTON, 1950, American Midland Naturalist, vol. 45, p. 178, new synonymy.

DIAGNOSIS: All palpal setae (except ventral tibial seta) feathered; galeal seta nude. Sensillary bases slightly behind posterolateral setae. Sensillae with minute barbs on the basal half. Fifty or more dorsal setae. There appear to be no characters by which *T. alaskensis* can be separated

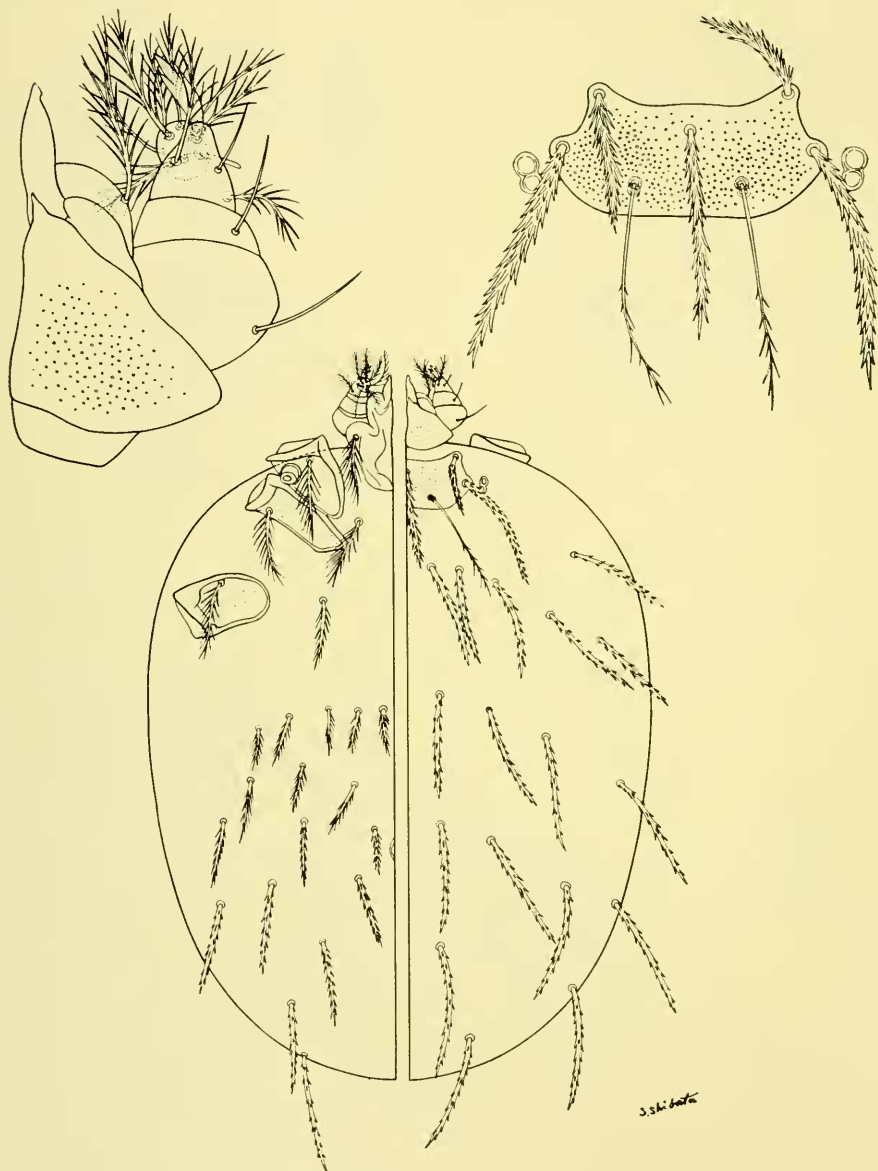


Fig. 24 *Trombicula yasukai*

from *T. pomeranzevi*. North American specimens of *T. alaskensis* were compared with *T. pomeranzevi* from Hokkaido, and there are no differences of specific merit. Dr. Brennan examined some of the Japanese specimens of *T. pomeranzevi* and concurred with our opinion. Scutal measurements



Fig. 25 *Trombicula himizu*

of a specimen from Hokkaido: AW-85.0, PW-112.5, SB-32.5, ASB-42.5, PSB-32.5, AP-36, AM-62.5, AL-65, PL-75, S-112.5.

DISTRIBUTION AND HOSTS: Known from *Clethrionomys rutilus* and *Apodemus speciosus* from Aomori and Ishikari prefectures. Known also from U.S.S.R. and North America.

TYPE DATA: Described from *Clethrionomys rufocanus* and *Apodemus speciosus* from South Shore, vicinity of Barrabasha, U.S.S.R.; June 19, August 5, and September 24, 1940.

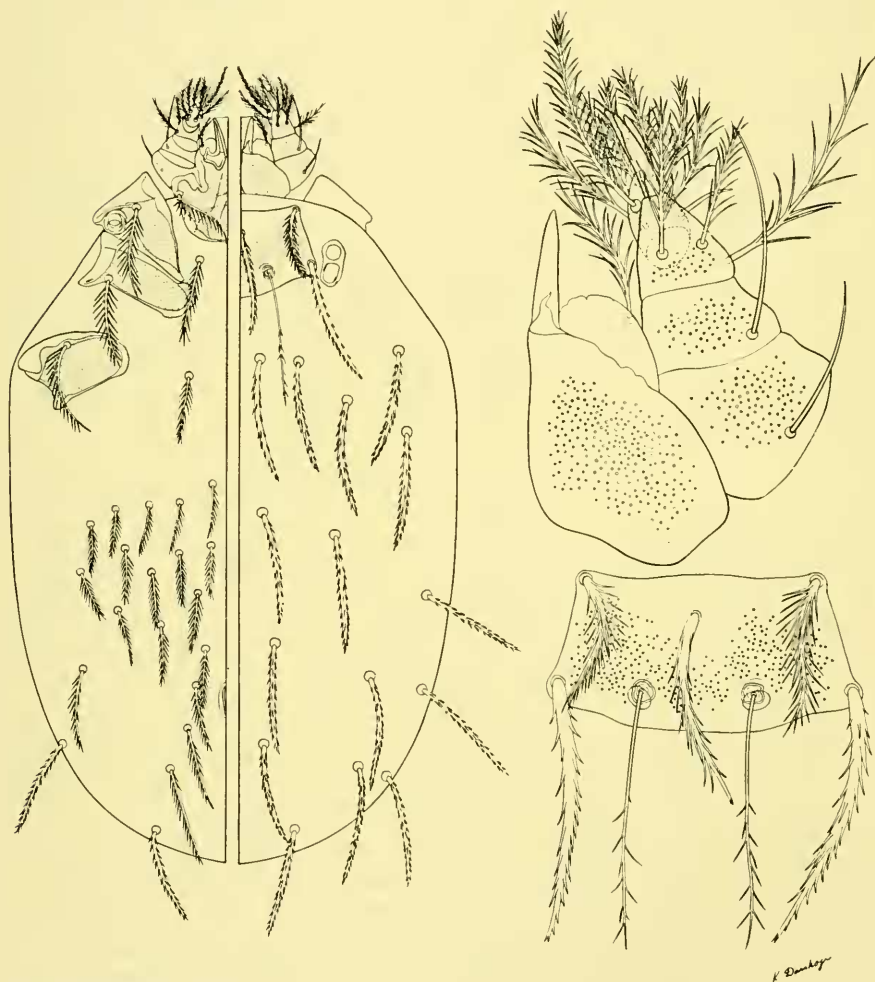


Fig. 26 *Trombicula miyajimai*

Subgenus **Leptotrombidium** Nagayo *et al.*, 1916

In *Leptotrombidium* the palpal femoral and genual setae are nude; the palpal claw is three-pronged (the prongs being closely appressed); the galeal seta is feathered; the scutum more or less rectangular; the sternal setae 2-2; the coxal setae 1-1-1; and there are no mastitarsalae III. Important specific characters in this group are the shape of the scutum, position of sensillary bases, character of the sensillae and scutal setae, number and character of dorsal body setae, and the position of the seta on coxa III.

There are 18 species of *Leptotrombidium* in Japan, a rather large concentration of forms: this figure does not include several probable synonyms; and, as there are doubtless others to be discovered, our list is conservative. Only four of these species (*T. palpalis*, *T. akamushi*, *T. pallida*, and *T. fuji*) are known to occur outside of Japan. The species of *Leptotrombidium* are usually common within their geographic range: *T. (L.) fuji*, *T. (L.) kitasatoi*, *T. (L.) palpalis*, *T. (L.) intermedia*, and *T. (L.) scutellaris* have a rather broad geographic distribution and are commonly collected. *Trombicula akamushi*, so frequently mentioned in accounts of tsutsugamushi disease and the chief vector of this disease in Japan, is actually confined to a small area in Japan and only locally common. Although most species seem to have no well developed host specificity, a few species seem closely associated with one kind of mammal: *Trombicula himizu* is typically a parasite of the shrew-mole (*Urotrichus talpoides*) as is *T. miyairii* and *T. tenjin*, and bats (*Myotis macrodactylus*) are the only known host of *T. toshiokai*.

KEY TO JAPANESE SPECIES OF LEPTOTROMBIDIUM

- | | |
|---|----------------------------|
| 1. Ventral palpal tibial seta feathered..... | 2 |
| — Ventral palpal tibial seta nude..... | 5 |
| 2. Lateral palpal tibial seta feathered..... | <i>T. (L.) miyajimai</i> |
| — Lateral palpal tibial seta nude..... | 3 |
| 3. Anterolateral and posterolateral setae similar..... | <i>T. (L.) palpalis</i> |
| — Posterolateral setae much heavier than anterolateral setae..... | 4 |
| 4. Posterolateral setae rasp-like, barbs short..... | <i>T. (L.) yasuoikai</i> |
| — Posterolateral setae pectinate, barbs long..... | <i>T. (L.) himizu</i> |
| 5. Seta on coxa III on anterior margin of coxa..... | 6 |
| — Seta on coxa III markedly behind the anterior margin of coxa..... | 7 |
| 6. First post-humeral row of setae usually ten..... | <i>T. (L.) tanaka-ryoi</i> |
| — First post-humeral row of setae usually eight..... | <i>T. (L.) fuji</i> |
| 7. Posterolateral setae in the angulate corners of the scutum..... | 8 |
| — Posterolateral setae in the anterior part of the rounded posterior corners of the scutum..... | 9 |

8. Sensillary bases in advance of the posterolateral setae; posterior margin of the scutum more or less straight.....*T. (L.) akamushi*
— Sensillary bases about on a line with posterolateral setae; posterior margin of scutum evenly rounded.....*T. (L.) scutellaris*

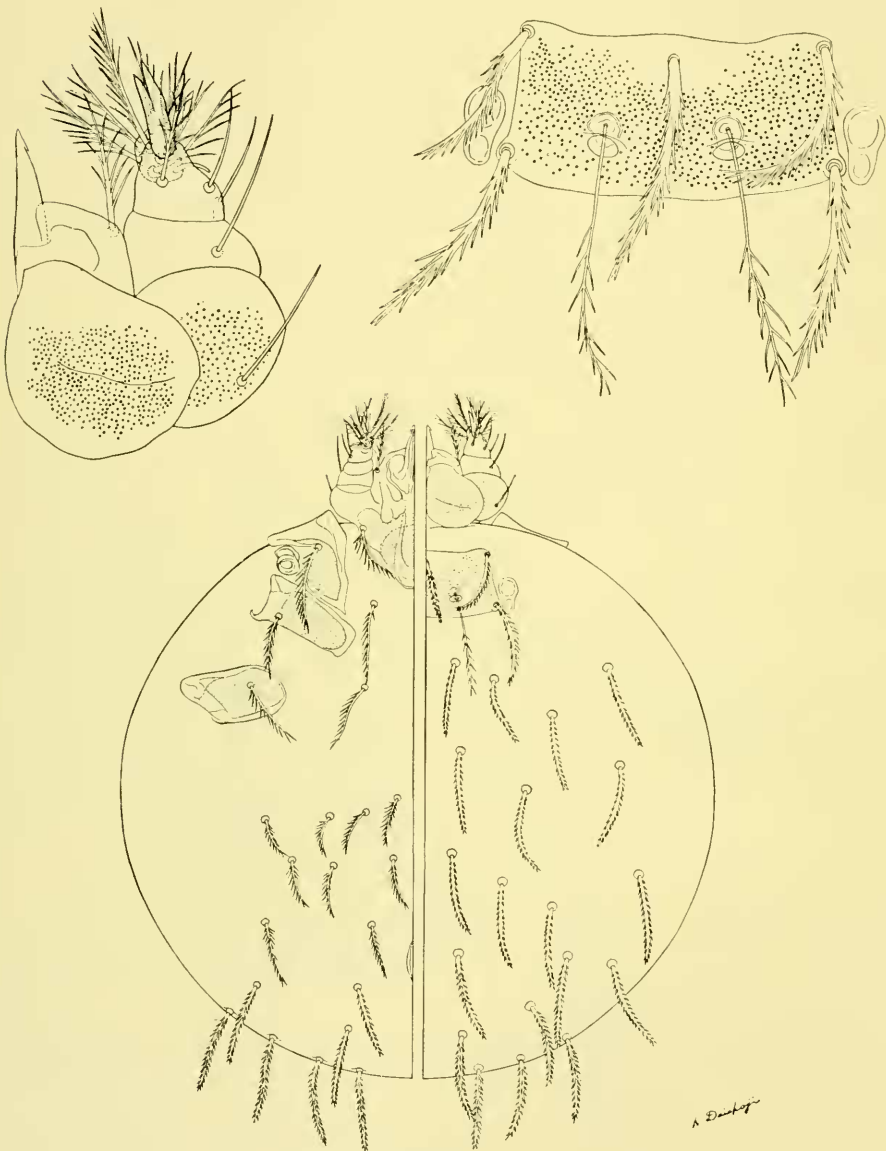


Fig. 27 *Trombicula akamushi*

9. Bases of sensillae nude..... 101
- Bases of sensillae barbed..... 15
10. Sensillary bases about on a line with posterolateral setae..... 11
- Sensillary bases clearly behind a line connecting posterolateral setae..... 13
11. Ventral palpal tibial seta shorter than the palpal genual seta; first post-humeral row of setae usually eight..... *T. (L.) kuroshio*
- Ventral palpal tibial seta as long or longer than the palpal genual seta; first post-humeral row of setae usually ten..... 12
12. Scutum about twice as wide as long; dorsal setae rather long, with the barbs rather appressed..... *T. (L.) intermedia*
- Scutum about two and one-half times as wide as long; dorsal setae rather short and bushy..... *T. (L.) teramurai*
13. Scutum more than twice as wide as long; usually two pairs of humeral setae..... *T. (L.) miyazakii*
- Scutum less than twice as wide as long; a single pair of humeral setae..... 14
14. Dorsal setae with barbs short..... *T. (L.) tenjin*
- Dorsal setae with barbs very long (and few in number)..... *T. (L.) miyairii*
15. Basal barbs of sensillae divergent, conspicuous..... 18
- Basal barbs of sensillae delicate and appressed..... 16
16. Sensillary bases markedly behind a line connecting the posterolateral setae..... *T. (L.) miyairii*
- Sensillary bases approximately on a line connecting the posterolateral setae..... 17
17. Scutum slightly less than twice as wide as long; ventral and lateral palpal tibial setae subequal..... *T. (L.) toshiokai*
- Scutum slightly more than twice as wide as long; ventral palpal tibial seta much longer than lateral palpal tibial seta..... *T. (L.) intermedia*
18. First post-humeral row of setae 12-15; dorsal setae shorter than length of scutum..... *T. (L.) pallida*
- First post-humeral row of setae 8-10; dorsal setae longer than scutum..... 19
19. Dorsal setal formula 2-10-8-8-6-4-2..... *T. (L.) tosa*²
- Dorsal setal formula 2-8-6-6-2-2..... *T. (L.) kitasatoi*

***Trombicula (Leptotrombidium) palpalis* Nagayo *et al.*, 1919**

(Figure 23)

Trombicula palpalis NAGAYO, MITAMURA, and TAMIYA, 1919, Jikken Igaku Zasshi, vol. 3, no. 4, pp. 265-312.

DIAGNOSIS: The ventral palpal tibial seta is feathered. Sensillary bases about on a line with the posterolateral setae. Sensillae basally nude (or

1. Species in which the barbs are very minute will key out in both halves of this couplet.

2. Possibly a synonym of *T. kitasatoi*.

with a few very small barbs), with numerous barbs on the distal half. Scutum approximately twice as broad as long; posterior corners well rounded, and posterolateral setae in the anterior part of these corners, well in advance of the posterior margin of the scutum. Specimens from mountain areas have a tendency to have more dorsal setae than specimens from

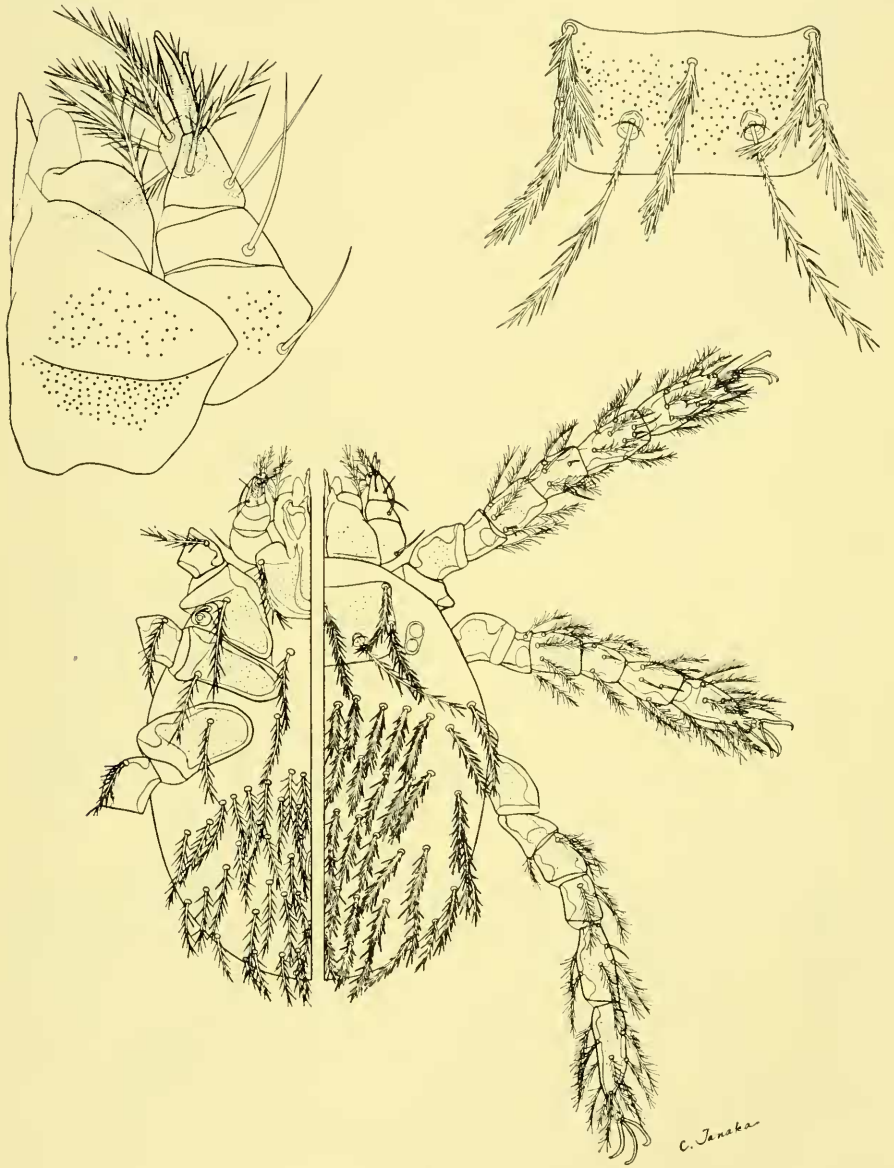


Fig. 28 *Trombicula pallida*

valleys and low grasslands. In such slightly aberrant mountain specimens, the rows of setae will be crowded and irregular.

DISTRIBUTION AND HOSTS: Saitama, Nanagawa, Gumma, Yamagata, Akita, Okayama, Yamanashi, and Ishikari prefectures from *Microtus montebelloi*, *Clethrionomys rufocanus*, *C. smithii*, *Apodemus speciosus*, *Rattus norvegicus*, *Urotrichus talpoides*, and *Passer montanus*. This chigger has also been collected in southern Korea.

TYPE DATA: A lectotype has been selected from specimens collected from *Microtus montebelloi* by the original authors at Yachi, Yamagata; March 27, 1919; deposited at Institute for Infectious Diseases, University of Tokyo.

Trombicula (Leptotrombidium) yasuokai Sasa *et al.*, 1952
(Figure 24)

Trombicula yasuokai SASA, KAWASHIMA, and HIROMATSU, 1952, Tokyo Iji Shinshi, vol. 69, no. 1, p. 43.

DIAGNOSIS: Ventral tibial seta of palpus feathered. Cheliceral base with scattered punctae. Sensillary bases markedly behind posterolateral setae. Sensillae basally nude, with scattered barbs on distal half. Hind margin of scutum more or less three sided: straight immediately behind and between the sensillae, and directly anteriorly near the posterolateral setae. Posterolateral and anteromedian setae distinctly heavier than anterolateral setae and with rasp-like, heavy barbs. Scutal measurements of holotype: AW-62.5, PW-81, SB-35, ASB-30, PSB-11.5, AP-19.5, AM-69.5, AL-43.5, PL-72.5, S-66.5

DISTRIBUTION AND HOSTS: Known from Kochi Prefecture from *Mogera wogura*.

TYPE DATA: Holotype and one paratype from Sakiyama, Muroto-machi, Kochi Prefecture from *Mogera wogura*; collected by Y. Hiromatsu, August 26, 1951. Holotype and paratype deposited at Institute for Infectious Diseases, University of Tokyo.

REMARKS: The original illustration shows the sensillary barbs to be short and scale-like, and the scutum to be evenly rounded on the hind margin near the posterolateral setae. The actual condition of the holotype is shown in the accompanying figure.

Trombicula (Leptotrombidium) himizu Sasa *et al.*, 1951
(Figure 25)

Trombicula himizu SASA, KUMADA, HAYASHI, ENOMOTO, FUKUZUMI, and OBATA, 1951, Eisei Doobutsu, vol. 2, no. 1, pp. 1-5.

DIAGNOSIS: Ventral tibial seta of palpus feathered. Sensillary bases behind posterolateral setae. Sensillae basally nude, with scattered barbs

distally. Posterolateral setae in advance of the rounded posterior corners of the scutum. Anteromedian and posterolateral setae with very heavy shafts and rather stout barbs. The numerous dorsal setae similar in nature to the anteromedian and posterolateral setae of the scutum; the small number and large size of the barbs on these setae serve to separate *T. (L.) himizu* from the other species of *Leptotrombidium* with a feathered ventral tibial seta of the palpus. Scutal measurements of the holotype: AW-60.5, PW-72, SB-32, ASB-27.5, PSB-10.5, AP-19, AM-67, AL-44.5, PL-60.5, S-82.

DISTRIBUTION AND HOSTS: Kanagawa, Shizuoka, and Yamanashi prefectures, from *Urotrichus talpoides*, *Apodemus speciosus*, and *Microtus montebelloi*.

TYPE DATA: Holotype from Mt. Oyama, Kanagawa Prefecture, from *Urotrichus talpoides*; November 23, 1950. Three paratypes from the same host from Yamanaka, Yamanashi Prefecture, November 20, 1950. These



Fig. 29 *Trombicula tanaka-ryoi*

specimens are deposited at the Institute for Infectious Diseases, University of Tokyo; one specimen (paratype) deposited at the Kitasato Institute, Tokyo.

Trombicula (Leptotrombidium) miyajimai Fukuzumi and Obata, 1951
(Figure 26)

Trombicula miyajimai FUKUZUMI and OBATA, 1951, Kitasato Archives of Experimental Medicine, vol. 23, p. 5.

DIAGNOSIS: This is the only species of *Leptotrombidium* in Japan in which all the palpal tibial setae are feathered. The cheliceral base and, dorsally, the segments of the palpus bear numerous punctae. Sensillary bases about on a line with posterolateral setae. Posterolateral setae set in the rather sharp corners of the scutum. Hind margin of the scutum projecting slightly in the area behind and between the sensillae. Sensillae basally nude and distally with 8-12 barbs. Posterolateral setae rather heavy and with short fine barbs. Dorsal setae long and similar to posterolateral setae of scutum. Scutal measurements of holotype: AW-71.8, PW-86.8, AP-28.3, ASB-35, PSB-14, SB-31.7, AM-57.9, AL-46.1, PL-80.4, S-64.2.

DISTRIBUTION AND HOSTS: Kanagawa, Kyoto, Chichibu, Okayama, Gumma, and Koehi prefectures from *Apodemus speciosus*, *A. geisha*, *Clethrionomys smithii*, and *Microtus montebelloi*.

TYPE DATA: Holotype and five paratypes from *Apodemus speciosus* from Matsuda, Kanagawa Prefecture; October 9, 1950. Holotype and paratypes deposited at the Kitasato Institute.

Trombicula (Leptotrombidium) akamushi (Brumpt, 1910)
(Figure 27)

Trombidium akamushi BRUMPT, 1910, Précis de Parasitologie, 2nd ed., p. 506. Paris. Masson.

DIAGNOSIS: Palpal femoral and genual setae nude; lateral and ventral palpal tibial setae nude; dorsal palpal tibial seta feathered. Galcal seta feathered. Cheliceral base and palpal femur with numerous small punctae. Sensillary bases well in advance of the posterolateral setae (*T. (L.) akamushi* is unique in this respect among Japanese species of *Leptotrombidium*). Sensillae nude basally, plumose distally. Posterolateral setae placed in the angulate corners of the scutum. Seta of coxa III markedly behind the anterior margin of coxa. Scutal measurements (mean of five specimens from Akita Prefecture, from Fukuzumi and Obata, 1951, Kitasato Archives of Experimental Medicine, 23:8): AW-65.5, PW-73.3,

AP-28.6, ASB-18.9, PSB-17.1, SB-28.9, AM-53.3, AL-42.9, PL-51.7, S-60.0.

DISTRIBUTION AND HOSTS: This species in Japan seems to occur only along the grassy areas in the valleys of the four main rivers in northwest-



Fig. 30 *Trombicula fuji*

ern Honshu: the Shinano and Agano rivers in Niigata Prefecture, the Mogami River in Yamagata Prefecture, and the Omono River in Akita Prefecture. The most common host is *Microtus montebelloi*, but *Rattus norvegicus*, *Apodemus speciosus*, and several species of wild birds are also parasitized.

TYPE DATA: From man; no type locality was designated, but Tanaka collected his original material from Yuzawa, Akita Prefecture

REMARKS: As Philip (1947, American Journal of Hygiene, vol. 46, p. 60) pointed out, the original description of *T. akamushi* consists of a poorly executed drawing. It is uncertain what species is intended from the illustration, but the species illustrated here is one that workers today generally agree to call *Trombicula akamushi*. It has long been accepted in the literature as the vector (and more recently, the major vector) of tsutsugamushi disease in Japan; there is nothing to be gained by a change of names. Actually, the identification of the species shown by Brumpt is probably no more difficult than that of many original descriptions of that period. The feathered condition of the palpal femoral and genual setae, clearly shown in the original figure, indicate that the species shown was not a species of *Leptotrombidium*. Quite possibly the species shown is *Trombicula (Neotrombicula) japonica*. Apparently early workers identified what we now call *T. akamushi* without referring to the original description, thus giving rise to a misidentification which workers have followed ever since. The present assignment of names should stand.

***Trombicula (Leptotrombidium) pallida* Nagayo *et al.*, 1919**

(Figure 28)

Trombicula pallida NAGAYO, MITAMURA, and TAMIYA, 1919, Jikken Igaku Zasshi, vol. 3, pp. 265-312.

Trombicula burnsi SASA, TERAMURA, and KANO, 1950, Tokyo Iji Shinshi, vol. 67, no. 10, p. 22. *New synonymy*.

Trombicula murotoensis SASA and KAWASHIMA, 1951, Tokyo Iji Shinshi, vol. 68, no. 12, p. 16. *New synonymy*.

DIAGNOSIS: Scutum more or less rectangular, with the posterolateral setae well in the anterior part of the rounded posterior corners. Sensillary bases slightly behind a line connecting the posterolateral setae. Sensillae with conspicuous, and divergent (though small) basal barbs, distal two-thirds with branches. The dorsal setae in *T. pallida* are numerous, with 12-15 in the first post-humeral row; they are distinctive in being rather heavy and short with numerous barbs. Seta on coxa III placed well behind the anterior margin of the coxa. *Trombicula pallida* is highly variable, especially with regard to the number of dorsal setae. Scutal measurements of

an average specimen: AW-72, PW-78, SB-36, ASB-33, PSB-15, AP-20, AM-54, AL-45, PL-72, S-60.

DISTRIBUTION AND HOSTS: This is a common and widely distributed species in Japan, and is known to occur also in southern Korea. Yamagata, Kanagawa, Saitama, Akita, and Kyoto prefectures, and Oshima and Miyake islands from *Crocidura dsinezumi*, *Apodemus speciosus*, *Clethrionomys smithii*, *Rattus norvegicus*, *Microtus montebelloi*, and small birds.

TYPE DATA: Lectotype selected from specimens collected by the original authors at Yachi, Yamagata Prefecture; March 27, 1919, from *Microtus montebelloi*; deposited at the Institute for Infectious Diseases, University of Tokyo.

REMARKS: *Trombicula burnsi* and *T. murotoensis* are regarded as synonyms of *T. pallida*.



Fig. 31 *Trombicula kitasatoi*

***Trombicula (Leptotrombidium) tanaka-ryoi* Kawashima and Sasa, 1952**
(Figure 29)

Trombicula tanaka-ryoi KAWASHIMA and SASA, 1952, Tokyo Iji Shinshi, vol. 69, no. 2, p. 21.

Trombicula tanaka-ryoi MITSUTOMI, SASA, HAYASHI, ETŌ, KOBAYASHI, and KITAHARA, 1952, Tokyo Iji Shinshi, vol. 69, no. 4, p. 18 (Original illustration).

DIAGNOSIS: Very close to *T. fuji* Kuwata *et al.*, 1950. *Trombicula tanaka-ryoi* differs in the shorter genual palpal seta, the larger scutum, and the dorsal setal formula. The scuta of the two species are remarkably similar, but in *T. tanaka-ryoi* the scutum is approximately twice as wide as long whereas in *T. fuji* it is less than twice as wide as long. The sensillary bases in both species are far behind a line connecting the posterolateral setae, and the sensillae possess conspicuous, divergent basal barbs in both species. In *T. tanaka-ryoi* the first post-humeral row of dorsal setae is usually ten and in *T. fuji* it is usually eight. In both species the seta on coxa III arises from the anterior margin of the coxa. Scutal measurements of holotype: AW-64, PW-64, SB-29, AP-17.5, SD-43, PSB-13, ASB-30, AM-44.5, AL-36, PL-62.5, S-56.5.

DISTRIBUTION AND HOSTS: Okayama, Kochi, Kyoto, Kumamoto, Oita, Shiga, Ehime, Mie, Tottori, Shimane, and Nara prefectures from *Crocidura dsi-nezumi*, *Apodemus speciosus*, and *Clethrionomys smithii*.

TYPE DATA: Holotype from Mt. Ishiguchi, Ehime Prefecture, from *Clethrionomys smithii*; collected by Ryo Tanaka; September 10, 1951. One paratype with the same data, and three paratypes from *Apodemus speciosus* with the same data. Deposited at the Institute for Infectious Diseases.

***Trombicula (Leptotrombidium) fuji* Kuwata *et al.*, 1950**
(Figure 30)

Trombicula (Leptotrombidium) fuji KUWATA, BERGE, and PHILIP, 1950, Journal of Parasitology, vol. 36, p. 80.

DIAGNOSIS: The very long palpal genual seta of *T. fuji* is distinctive. The scutum is small and the sensillary bases are placed far behind a line connecting the posterolateral setae. The first post-humeral row of setae is almost always of eight setae. The seta on coxa III arises from the anterior margin of the coxa. (See also diagnosis for *T. tanaka-ryoi*.) Scutal measurements of holotype: AW-50.5, PW-52, SB-24, AP-14, SD-30.5, PSB-11, PL-SB-10.5, AM-29.5, AL-28.5, PL-51, S-40.5.

DISTRIBUTION AND HOSTS: Aomori, Akita, Yamagata, Niigata, Gumma, Saitama, Chiba, Tokyo, Kanagawa, Yamanashi, Nagano, Hyogo, Okayama, Shimane, Oita, Kumamoto, Shizuoka, Kyoto, Mie, Shiga, Fukuoka, and Kochi prefectures from *Apodemus speciosus*, *A. geisha*, *Rattus norvegicus*,

R. rattus, *Clethrionomys smithii*, and *Microtus montebelloi*. Known also from the Pescadores.

TYPE DATA: From *Apodemus speciosus* from east slope of Mt. Fuji, Fujino Susuno (near Gotemba), Shizuoka Prefecture; October 30, 1948, collected by Major Trygve O. Berge; deposited at the United States National Museum.

***Trombicula* (*Leptotrombidium*) *kitasatoi* Fukuzumi and Obata, 1950**
(Figure 31)

Trombicula kitasatoi FUKUZUMI and OBATA, 1950, Kitasato Archives of Experimental Medicine, vol. 23, no. 3, p. 79.

DIAGNOSIS: Scutum more than twice as wide as long; posterolateral setae in the anterior part of the rounded corners of the scutum. Sensillary



Fig. 32 *Trombicula tosa*

bases about on a line with posterolateral setae; basal third of sensillae with conspicuous, divergent barbs. First post-humeral row of dorsal setae usually eight. Seta of coxa III markedly behind the anterior margin of the coxa. Scutal measurements of holotype: AW-70.4, PW-79.2, AP-22.0, SB-33.9, ASB-25, PSB-15, AM-51.7, AL-40.0, PL-73.3, S-53.2.

DISTRIBUTION AND HOSTS: Common and widely distributed. Saitama, Yamagata, Fukushima, Kanagawa, Chiba, Gumma, Kyoto, Shiga, Mie, Okayama, Fukuoka, Kagoshima, Kumamoto, Oita, and Kochi prefectures from *Apodemus speciosus*, *A. geisha*, *Rattus norvegicus*, *R. rattus*, *Clethrionomys smithii*, and *Microtus montebelloi*.

TYPE DATA: From *Apodemus speciosus* from Tsurumi, Kanagawa Prefecture; September 9, 1950; collected by the original describers; deposited at the Kitasato Institute, Tokyo.

***Trombicula (Leptotrombidium) tosa* Sasa and Kawashima, 1951**
(Figure 32)

Trombicula tosa SASA and KAWASHIMA, 1951, Tokyo Iji Shinshi, vol. 68, no. 10, p. 10.

DIAGNOSIS: Very similar to *T. kitasatoi*, differing only in the dorsal setal formula: in *T. tosa* it is 2-10-8-8-6-4-2 and in *T. kitasatoi* it is 2-8-6-6-2-2. In the original description the enlarged drawing of the scutum shows the hind margin to be evenly rounded but the holotype is as illustrated in the accompanying figure in this paper. Scutal measurements of holotype: AW-70, PW-78, SB-32, ASB-29, PSB-13, SD-42, AP-22, TM-52, AL-37, PL-65, S-56.

DISTRIBUTION AND HOSTS: From Kochi Prefecture from *Rattus norvegicus* and *R. Rattus*. This species is abundant in sweet potato fields and residential areas in the coast-line area of western Kochi. *Trombicula tosa* occurs exclusively in the summer months; from near-by areas of scrub and forest, *T. kitasatoi* occurs from autumn to spring.

TYPE DATA: Holotype and five paratypes from *Rattus norvegicus* from Ida, Kochi Prefecture; June 29, 1951; deposited at the Institute for Infectious Diseases.

REMARKS: When the biology and complete life histories of *T. kitasatoi* and *T. tosa* are better known, the latter may prove to be a biological variant or a synonym of *T. kitasatoi*. Among a series of specimens mounted on a single slide, five clearly belong to *T. tosa* and one definitely to *T. kitasatoi*.

***Trombicula (Leptotrombidium) miyairii* Sasa et al., 1952**
(Figure 33)

Trombicula miyairii SASA, HAYASHI, KAWASHIMA, MITSUTOMI, and EGASHIRA, 1952, Tokyo Iji Shiushi, vol. 69, no. 3, p. 11.

DIAGNOSIS: Gnathosoma similar to that of *T. akamushi*. Scutum small, about twice as wide as long; with posterior margin projected considerably behind the posterolateral setae. Sensillary bases considerably behind posterolateral setae. Bases of sensillae with minute barbs; distal half with two or three very long branches. Posterolateral setae heavy, with the shaft thick and the branches heavy and long. Dorsal body setae



Fig. 33 *Trombicula miyairii*

similar to posterolateral setae. Scutal measurements of holotype: AW-59, PW-60, SB-29, ASB-31, PSB-14, AP-15, AM-40.5, AL-35, PL-62, S-52.

DISTRIBUTION AND HOSTS: To date all specimens have been collected from *Urotrichus talpoides* from Kumamoto, Oita, and Ehime prefectures.

TYPE DATA: Holotype from *Urotrichus talpoides* from Toshita (near Mt. Aso), Kumamoto Prefecture; October 21, 1951; three paratypes with the same data; two paratypes from Mt. Ishijuchi, Ehime Prefecture; September 8, 1951. Holotype and all paratypes deposited at Institute for Infectious Diseases.

***Trombicula (Leptotrombidium) tenjin* Sasa *et al.*, 1951**

(Figure 34)

Trombicula tenjin SASA, HAYASHI, KUMADA, and MIURA, 1951, Tokyo Iji Shinshi, vol. 68, no. 3, p. 17.

DIAGNOSIS: Gnathosoma similar to that of *T. akamushi*; the branched palpal setae with fewer and longer branches. Scutum about twice as wide as long; with numerous scattered punctae; posterior margin projected far behind posterolateral setae, with a slight mesal concavity. Sensillary bases far behind a line connecting the posterolateral setae. Sensillae rough and rasp-like basally, with six to eight rather long barbs on the distal half or two-thirds. Barbs on scutal setae rather heavy, not especially long. Dorsal setae similar to scutal setae. Scutal measurements of holotype: AW-63.0, PW-70.0, AP-21.5, ASB-28.0, PSB-10.0, SB-30.5, AM-41.0, AL-38.0, PL-80.5, S-48.5.

DISTRIBUTION AND HOSTS: Known from Kanagawa Prefecture from *Urotrichus talpoides*.

TYPE DATA: From *Urotrichus talpoides* from Okuyugawa, Kanagawa Prefecture; November 12, 1950; deposited at the Institute for Infectious Diseases.

***Trombicula (Leptotrombidium) teramurai* Sasa *et al.*, 1951**

(Figure 35)

Trombicula teramurai SASA, KUMADA, and TERAMURA, 1951, Tokyo Iji Shenshi, vol. 68, no. 9, p. 8.

DIAGNOSIS: Gnathosoma similar to that of *T. akamushi*. Scutum more than twice as wide as long (almost three times as wide as long); lateral margins markedly concave; posterior margin projected considerably behind posterolateral setae, but slightly concave mesally; with scattered punctae. Sensillary bases slightly behind a line connecting posterolateral setae.

Bases of sensillae nude; distal two-thirds plumose. Dorsal setae rather short and plumose, as illustrated. Scutal measurements of holotype: AW-70, PW-80, SB-31, ASB-28, PSB-14, AP-17, AM-59, AL-38, PL-58.5, S-67.



Fig. 34 *Trombicula tenjin*

DISTRIBUTION AND HOSTS: From Niigata, Akita, and Yamagata from *Microtus montebelloi*, *Apodemus speciosus*, and *Urotrichus talpoides*.

TYPE DATA: Holotype and twelve paratypes from *Microtus montebelloi* from Akakura, Niigata Prefecture; April 24, 1951; deposited at Institute for Infectious Diseases.

REMARKS: The original illustration of the scutum errs in showing it too narrow; the illustration in this paper, made from the holotype, is accurate.

***Trombicula (Leptotrombidium) kuroshio* Sasa and Kawashima, 1952**

(Figure 36)

Trombicula kuroshio SASA and KAWASHIMA, 1952, Tokyo Iji Shinshi, vol. 68, no. 12, p. 15.

DIAGNOSIS: Gnathosoma similar to that of *T. akamushi*; genual seta distinctly longer than ventral tibial seta. Scutum more than twice as wide as long; posterior corners more or less rounded. Sensillary bases distinctly behind a line connecting posterolateral setae. Base of sensillae nude, distal two-thirds plumose. The posterior margin of the scutum is usually more or less three-sided, sometimes irregularly rounded. Scutal measurements of holotype: AW-55, PW-63, SB-24, ASB-27, PSB-10, AP-16, AM-37, AL-32.5, PI-59, S-47.

DISTRIBUTION AND HOSTS: From Kagoshima, Kumamoto, Oita, and Shiga prefectures, from *Apodemus speciosus* and *Clethrionomys smithii*.

TYPE DATA: Holotype and seven paratypes from *Apodemus speciosus* from Maruyama, Muroto-machi, Koehi Prefecture; August 26, 1951; deposited at the Institute for Infectious Diseases.

***Trombicula (Leptotrombidium) toshiokai* Sasa and Jameson, new species**

(Figure 37)

This species is one of two kinds of chiggers collected from bats in Japan; it is known only from this host.

GNATHOSOMA: Cheliceral base with a few punctae; a few small punctae on dorsal part of palpal femur. Chelicera with a subapical dorsal tooth. Palpal setae essentially as in *T. akamushi*: femoral, genual, and lateral and ventral tibial setae nude; dorsal tibial seta feathered. Galeal seta feathered.

LEGS: All coxa unisetosa; seta on coxa III distinctly behind the anterior margin of the coxa. Specialized (nude) setae: Leg I, 2 genulae, 1 microgenuala, 2 tibialae, 1 microtibiala, 1 spur, 1 microspur, 1 subterminala,

1 parasubterminala, 1 pretarsala; Leg II, 1 genuala, 2 tibialae, 1 spur, 1 pretarsala; Leg III, 1 genuala, 1 tibiala.

SCUTUM: About twice as wide as long (in *T. intermedia* and *T. miyazakii* the scutum is at least slightly more than twice as wide as long). Sen-

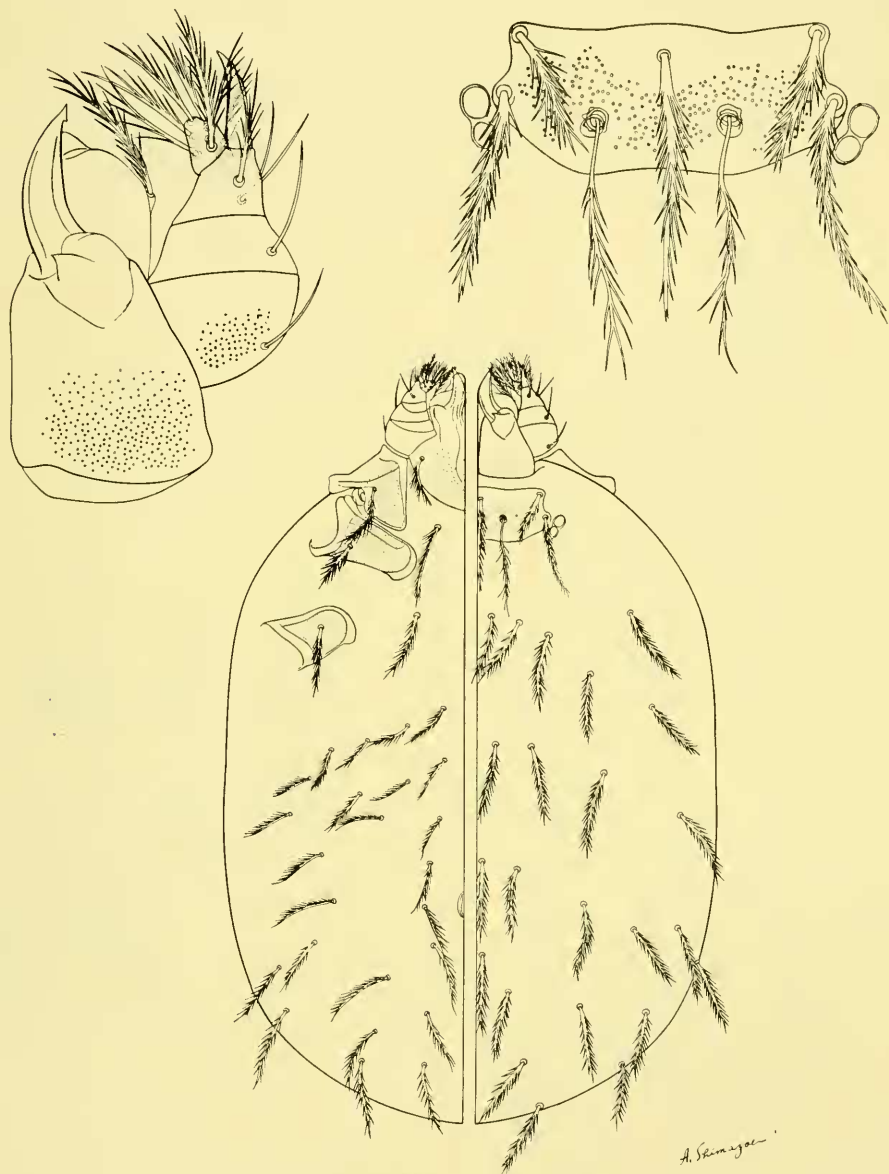


Fig. 35 *Trombicula teramurai*

sillary bases slightly behind a line connecting the posterolateral setae. Sensillae with minute and inconspicuous basal barbs, distal half plumose. Posterior margin of the scutum rounded, concave mesally. Punctae few. Scutal measurements of holotype: AW-91, PW-110, SB-48, ASB-42, PSB-18, AP-35, AM-77, AL-59, PL-84, S-70.

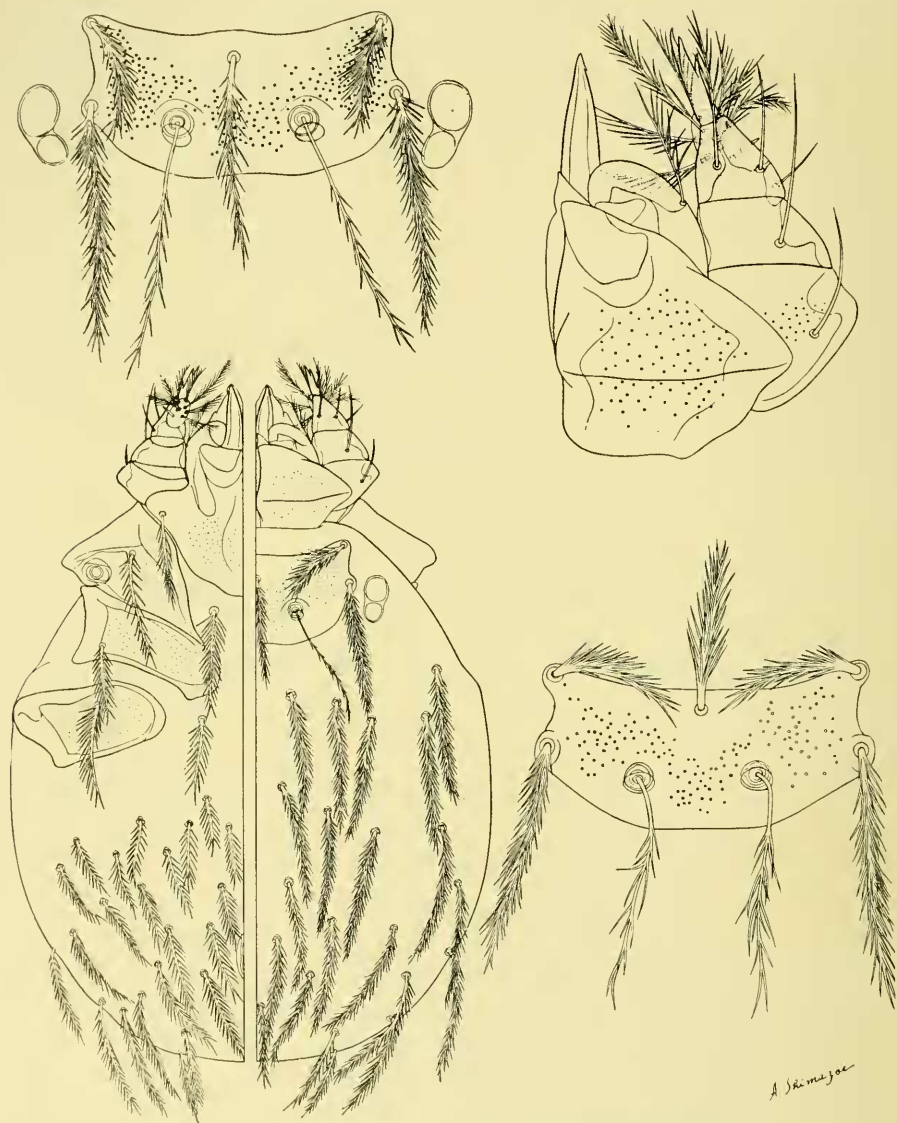


Fig. 36 *Trombicula kuroshio*

SETAE: Dorsal setae quite long, with few barbs. Dorsal setae formula: 2-14(12-15)-12-10(10-12)-8-4. Sternal setae 2-2. About 45-50 small setae behind sternal setae, ventrally.

TYPE DATA: Holotype and ten paratypes from *Myotis macrodactylus* from the bat caves at Nikko, Tochigi Prefecture; collected by Seiichi Toshioka and William Suyemoto, September 4, 1952; two additional specimens from the same host from Kyoto Prefecture collected by Yukio Shogaki and J. McClendon. Holotype and five paratypes deposited in United States National Museum; one paratype deposited in Institute for Infectious Diseases, University of Tokyo.

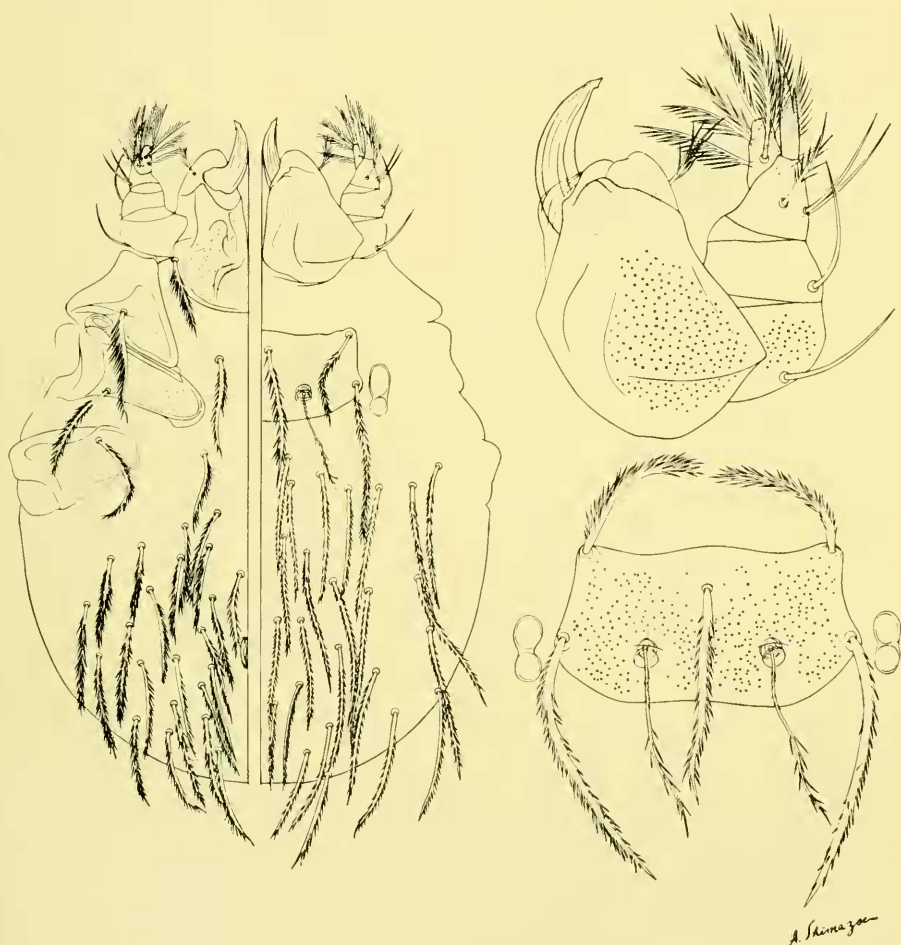


Fig. 37 *Trombicula toshiokai*

***Trombicula (Leptotrombidium) miyazakii* Sasa *et al.*, 1951**

(Figure 38)

Trombicula miyazakii SASA, SAWADA, KANO, HAYASHI, and KUMADA, 1951, Tokyo Iji Shinshi, vol. 68, no. 4, p. 7.

Fig. 38 *Trombicula miyazakii*

DIAGNOSIS: Gnathosoma similar to that of *T. akamushi*. Scutum slightly more than twice as wide as long; posterolateral setae in the anterior part of the rounded posterior corners. Sensillary bases slightly behind a line



Fig. 39 *Trombicula intermedia*

connecting the posterolateral setae. Basal third of sensillar nude, distal two-thirds plumose. First two post-humeral rows of dorsal setae very close together, together with about twenty setae. Two pairs (usually) of humeral setae. Dorsal setae much more numerous than in most Japanese species of *Leptotrombidium*. Scutal measurements of holotype: AW-80, PW-91, AP-25, SB-40.5, ASB-25.5, PSB-17.5, AM-64, AL-46.5, PL-71.5, S-76.

DISTRIBUTION AND HOSTS: Gumma, Kanagawa, Saitama, Gifu, Nagano, and Ehime prefectures from *Apodemus speciosus* and *Clethrionomys smithii*.

TYPE DATA: A holotype and a paratype from *Apodemus speciosus* from Ikao, Gumma Prefecture, November 27, 1950; deposited at the Institute for Infectious Diseases, University of Tokyo.

***Trombicula (Leptotrombidium) intermedia* Nagayo *et al.*, 1920**

(Figure 39)

Trombicula intermedia NAGAYO, MITAMURA, and TAMIYA, 1920, Verhandelingen Japanische Pathologische Gesellschaft, vol. 10, p. 147.

DIAGNOSIS: Gnathosoma similar to that of *T. akamushi*, but with the ventral tibial seta of the palpus very long. Scutum with the rear margin convex with a slight mesal concavity; hind corners rounded; the outline of the rear margin is quite variable. Sensillary bases about on a line with the posterolateral setae. Basal third of sensillae with minute, inconspicuous barbs; distal two-thirds of sensillae plumose. Dorsal setae rather long, with barbs short. Scutal measurements (from Fukuzumi and Obata, 1950, Kitasato Archives of Experimental Medicine, 23: 81): "AW-68.6, PW-80.7, AP-25.3, ASB-20.7, PSB-12.8, SB-36.5, AM-50.6, AL-44.0, PL-62.5, S-66.0."

DISTRIBUTION AND HOSTS: This species is very common and widely distributed throughout the mountain areas of eastern Honshu and Hokkaido: Akita, Yamagata, Niigata, Aomori, Ishikari, Gumma, Yamanashi, Shizuoka, Nagano, Kyoto, Shiga, and Oita prefectures. It is known from *Urotrichus talpoides*, *Apodemus speciosus*, *Clethrionomys smithii*, *C. rufocanus*, and *Microtus montebelloi*.

TYPE DATA: The original description is based on specimens collected at Arato, Yamagata Prefecture. A lectotype (remounted) selected from the original series, was collected from *Microtus montebelloi*; Arato, Yamagata Prefecture; October 20, 1920; deposited at the Institute for Infectious Diseases, University of Tokyo.

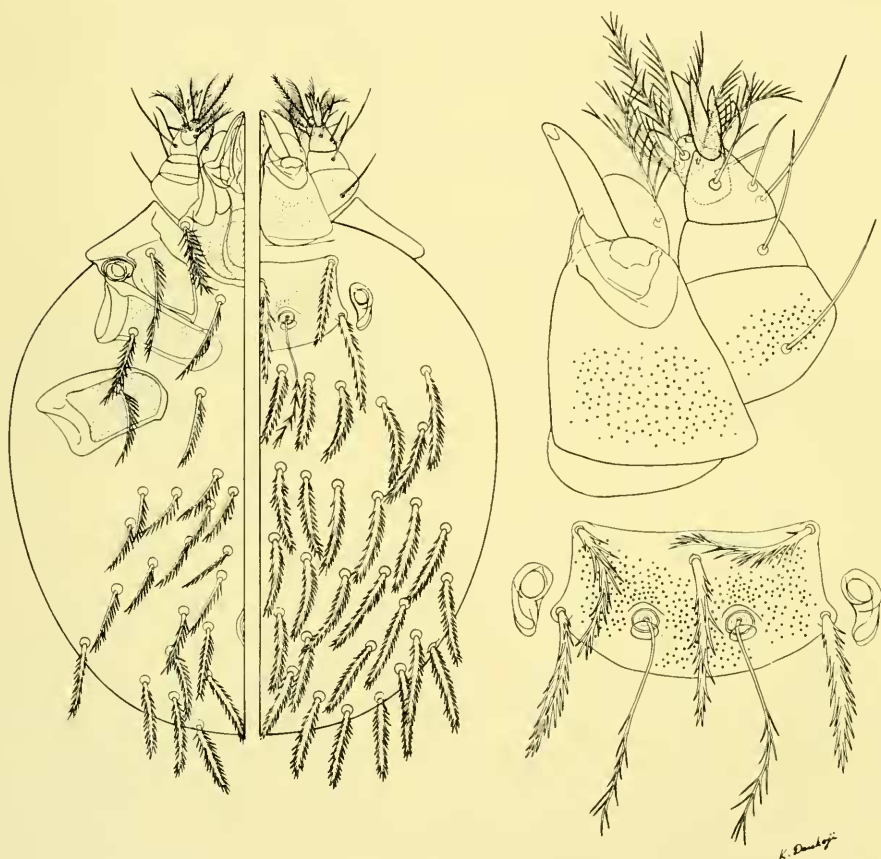
***Trombicula (Leptotrombidium) scutellaris* Nagayo *et al.*, 1921**

Figure (40)

Trombicula scutellaris NAGAYO, MIYAGAWA, MITAMURA, TAMIYA, and TENJIN, 1921, American Journal of Hygiene, vol. 1, pp. 569-591. (In nos. 5 and 6, September-November, 1921.)

Trombicula scutellaris NAGAYO, MITAMURA, TAMIYA, and TENJIN, 1931, Verhandelingen Japanische Pathologische Gesellschaft, vol. 11, p. 471. (December, 1921.)

DIAGNOSIS: Gnathosoma similar to that of *T. akamushi*; in *T. scutellaris* the ventral tibial seta of the palpus is very long whereas this seta in *akamushi* is quite short. Scutum similar to that of *T. akamushi* in that the posterolateral setae are placed in the rather angulate corners of the scutum; the sensillary bases are, however, about on a line with the posterolateral

Fig. 40 *Trombicula scutellaris*

setae (in *T. akamushi* the sensillary bases are distinctly in advance of the posterolateral setae). The rear margin of the scutum is convex and evenly rounded. The bases of the sensillae are nude, the distal half plumose. Seta on coxa III distinctly behind the anterior margin of the coxa. Scutal measurements of a topotype (from Kuwata *et al.*, 1950, *Journal of Parasitology*, vol. 36, p. 82): "AW-69.5, PW-82.5, AP-31.5, SB-31.5, PSB-19.5, AM-62, AL-52.5, PL-64, S-76.5."

DISTRIBUTION AND HOSTS: Known from Yamagata, Nagano, Niigata, Kagoshima, and Shizuoka prefectures and from the Izu Islands (south of Tokyo), from *Microtus montebelloi*, *Apodemus speciosus*, *Rattus norvegicus*, and several species of wild birds.

TYPE DATA: This species was first recognized as a distinct species by Kawamura in Niigata, but was described as new by Nagayo *et al.*, based on specimens collected at Yachi, Yamagata Prefecture, from *Microtus montebelloi*; October 24, 1920. A holotype is not preserved. A lectotype (remounted separately) is deposited at the Institute for Infectious Diseases, University of Tokyo.

REMARKS: In the Izu Islands *T. scutellaris* is the suspected vector of Shichito fever, a form of tsutsugamushi disease.

Subgenus **Eutrombicula** Ewing, 1938

Species of *Eutrombicula* commonly infest birds and reptiles, and not infrequently attack man, causing an irritating dermatitis. The palpal claw is two pronged, the axial prong being dorsal (or external); there are 20 or 22 dorsal setae; and with one or more mastitarsalae III. Only one species is known from Japan.

Trombicula (Eutrombicula) wichmanni (Oudemans, 1905)

(Figure 41)

Thrombidium wichmanni OUDEMANS, 1905, *Entomologische Berichten*, vol. 1, no. 22, p. 217.

Trombicula wichmanni SASA and KANO, 1950, *Tokyo Iji Shinshi*, vol. 67, no. 4, p. 9.

DIAGNOSIS: Palpal femoral seta feathered; palpal genual seta nude; dorsal and lateral setae of palpal tibia nude, and ventral tibial seta feathered. Palpal claw two pronged, the axial prong dorsal (or external). Spur on palpal thumb rather short. Galeal seta nude. Sternal setae 2-2. Coxal setae 1-1-1. One mastitarsala III. Sensillary bases well in advance of posterolateral setae. Sensillae basally nude, with 5-8 barbs on distal half.

Twenty or twenty-two dorsal setae. Scutal measurements of a specimen from Japan: AW-90, PW-108, SB-45, ASB-36, PSB-40, AP-39, AM-46, AL-45, PL-56, S-51.

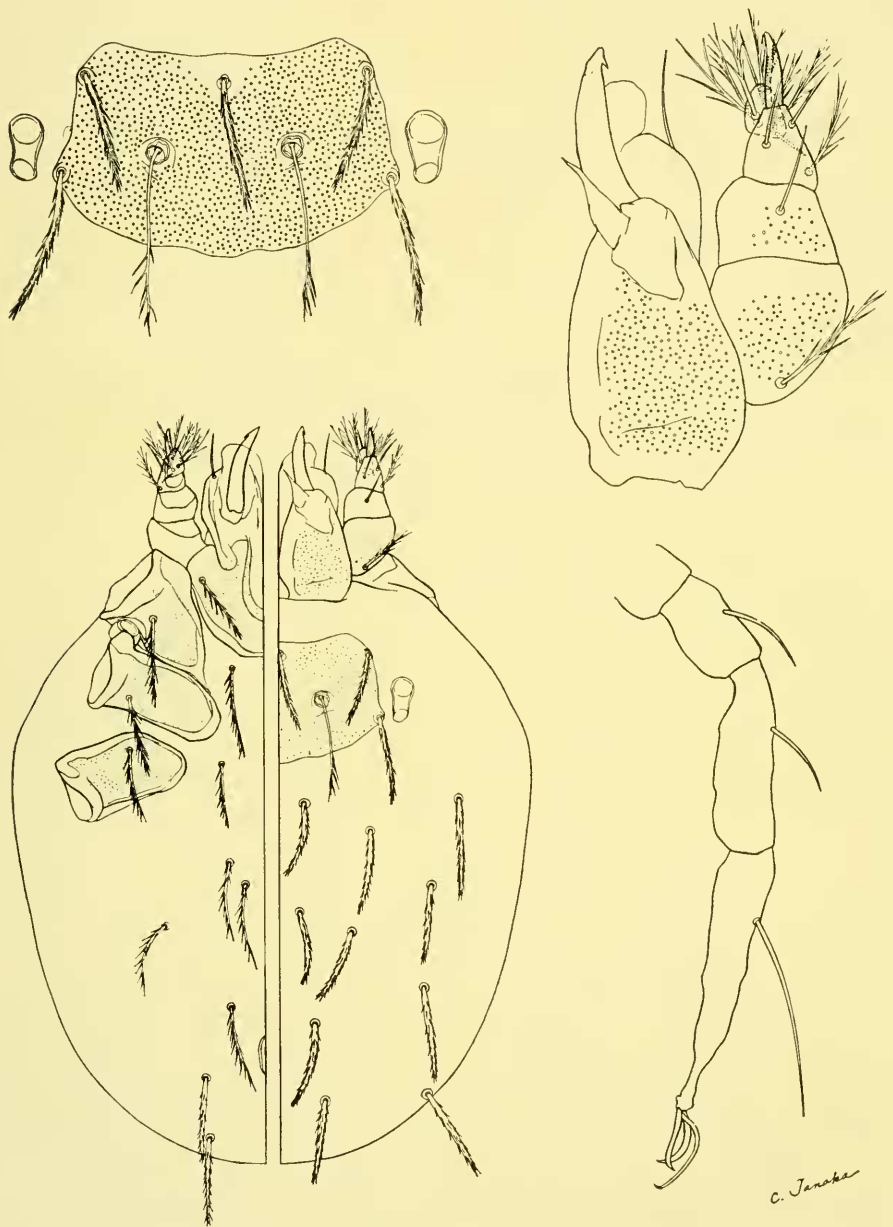


Fig. 41 *Trombicula wichmanni*

DISTRIBUTION AND HOSTS: This chigger is widely distributed in the warmer regions of the Orient. In Japan it occurs on Koshima and Haehijo islands (south of Tokyo) on *Rattus norvegicus*, wild birds, dogs, cats, and man.

TYPE DATA: Taken originally from the crowned pigeon from New Guinea and from man in North Celebes.

Ungrouped Species of *Trombicula*

The following species are placed together for convenience; they are not necessarily closely allied. It would create an erroneous impression to place them in a subgenus together, although some authors have so treated those species of *Trombicula* that do not fit into any of the established subgenera of *Trombicula*.

The first two species (*T. anous* and *T. shiraii*) would fall into the genus (or subgenus) *Acariscus* Ewing which we do not recognize; these two species seem both biologically and morphologically allied. *Trombicula koomori* and *T. hasegawai* are unrelated to each other and to other chiggers in Japan.

KEY TO UNGROUPED SPECIES OF *TROMBICULA* IN JAPAN

- | | |
|--|---------------------|
| 1. Palpal claw two-pronged; 1 mastitarsala III..... | 2 |
| — Palpal claw three-pronged; no mastitarsala III..... | 3 |
| 2. Sternal setae 2-2..... | <i>T. anous</i> |
| — Sternal setae 2-4..... | <i>T. shiraii</i> |
| 3. Posterior margin of scutum straight; bases of sensillae nude..... | <i>T. hasegawai</i> |
| — Posterior margin of scutum bluntly pointed; bases of sensillae with conspicuous barbs..... | <i>T. koomori</i> |

Trombicula anous (Wharton, 1945)

(Figure 42)

Acariscus anous WHARTON, 1945, Journal of Parasitology, vol. 31, p. 403.

Trombicula anous, KANO and SASA, 1952, Tokyo Iji Shinshi, vol. 69, no. 10, p. 15.

DIAGNOSIS: Palpal femoral and genual setae feathered; palpal tibial setae nude. Spur on palpal thumb very long and slender. Palpal claw two pronged, axial prong internal (or ventral). Galeal seta nude. Sternal setae 2-2. Coxal setae 1-1-1. Dorsal setae 32. Sensillae basally nude, with 5-7 barbs on the distal third. Sensillary bases well in advance of posterolateral setae. One mastitarsala III. Scutal measurements (mean of five specimens) as given by the describer: "AW-93, PW-101, SB-37, ASB-32, PSB-19, AP-30, AM-32, AL-53, PL-75, S-73." Scutal measurements of

a specimen from Miyake Island, south of Tokyo: AW-84, PW-89, SB-28.5, ASB-38, AP-32, AL-49, PL-81, S-84.



Fig. 42 *Trombicula anous*

DISTRIBUTION AND HOSTS: Originally known from *Anous stolidus* and *Heteroscelus incanus* from Guam. Two specimens from *Pluvialis dominicus* from Miyake Island, Japan.



Fig. 43 *Trombicula shiraii*

TYPE DATA: Type host not indicated; from Ypao Point, Guam, Mariana Islands. Holotype in the United States National Museum.

***Trombicula shiraii* Sasa, Kano, and Ogata, 1952**

(Figure 43)

Trombicula shiraii SAsA, KANo, and OGATa, 1952, Tokyo Iji Shinshi, vol. 69, no. 10, p. 14.

DIAGNOSIS: Femoral seta of palpus feathered; palpal genual and tibial setae nude. Palpal claw two pronged, axial prong internal (or ventral). Spur on palpal thumb long and slender. Galeal seta nude. Cheliceral base and palpal femur and genu with numerous punctae. Scutum more or less rectangular, about twice as broad as long. Sensillary bases in advance of posterolateral setae. Sensillae with basal half nude, with 5-7 barbs dis-

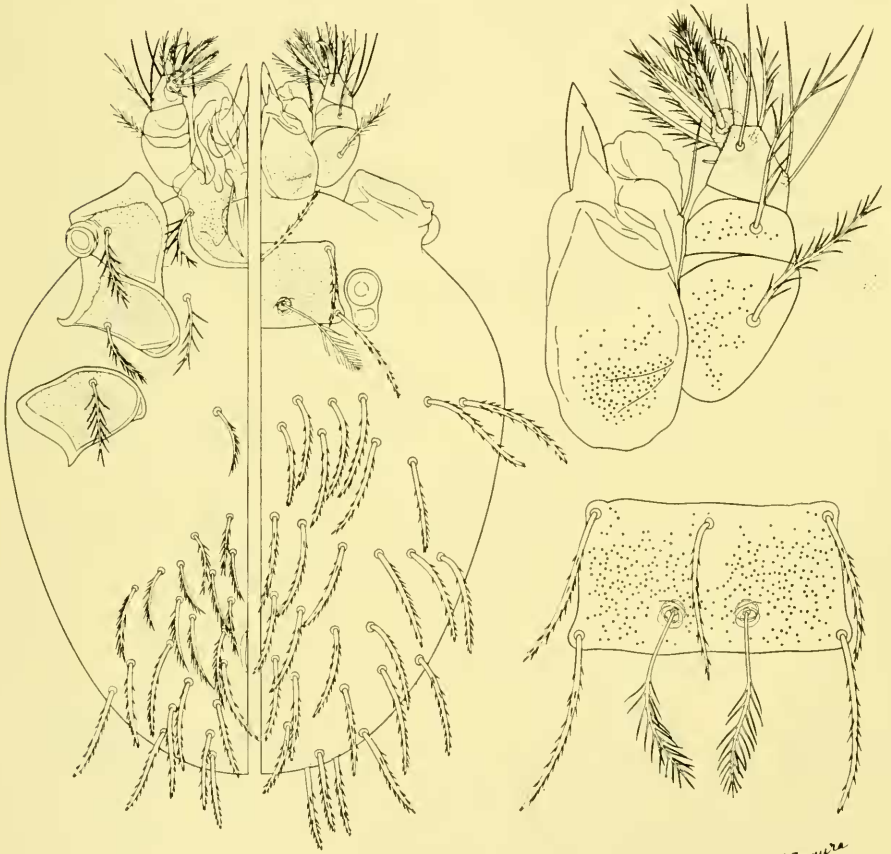


Fig. 44 *Trombicula hasegawai*

tally. Scutum with numerous punctae. Sternal setae 2-4. Coxal setae 1-1-1. One mastitarsala III. About 90 dorsal setae. Scutal measurements of holotype: AW-80.5, PW-89, SB-29.5, ASB-35, AP-32.5, AM-61, AL-49.5, PL-82, S-82.5.

DISTRIBUTION AND HOSTS: Known only from the original collection.

TYPE DATA: Holotype and one paratype from *Charadrius dominicus* from Tokyo; May 1, 1952. Holotype at Institute for Infectious Diseases, University of Tokyo.

***Trombicula hasegawai* Sasa *et al.*, 1953**

(Figure 44)

Trombicula hasegawai SASA, HAYASHI, and KAWASHIMA, 1953, Tokyo Iji Shinshi, vol. 70, no. 4, p. 15.

DIAGNOSIS: Palpal femoral and genual setae feathered; palpal tibial setae nude. Galeal seta nude. Palpal claw three-pronged. Cheliceral base and palpal femur and genu with fine punctae. Scutum rectangular, with posterior margin straight. Posterolateral setae in the rather angular corners of the scutum. Sensillary bases in advance of a line connecting the posterolateral setae. Bases of sensillae nude; distal half plumose. Two pairs of humeral setae. First two post-humeral rows of setae close together and appearing as a single irregular row of setae; fifty or more dorsal setae. Sternal setae 2-2. Coxal setae 1-1-1. Scutal measurements of holotype: AW-71.5, PW-80, SB-22, ASB-35, PSB-13.5, AP-35.5, AM-52, AL-48.5, PL-61, S-56.

DISTRIBUTION AND HOSTS: Known only from the type locality from *Turdus eclaenops*, *Passer montanus*, *Streptopelia orientalis*, *Janthoenas janthrine*, and *Monticola solitarius*.

TYPE DATA: Holotype and 10 paratypes from *Turdus eclaenops*, from Hachijo Island (south of Tokyo); September 4-10, 1952. Deposited at Institute for Infectious Diseases, University of Tokyo.

***Trombicula koomori* Sasa and Jameson, new species**

(Figure 45)

This species appears to have no close relatives in Japan, and is not very much like other known bat chiggers.

GNATHOSOMA: Cheliceral base with few punctae. Palpal femoral, genual, and lateral and ventral tibial setae all feathered; dorsal tibial seta nude and very long (exceeding the tip of the palpal claw). Palpal thumb with

four feathered setae; the spur rather short, its length about equal to the width of the palpal thumb. Palpal claw three-pronged. Galeal seta nude. Chelicera twisted apically, with no projections laterally or subapically.



Fig. 45 *Trombicula koomori*

SCUTUM: Slightly wider than long; posterior margin produced and somewhat pointed; with conspicuous scattered punctae. One of the three original specimens possesses two anteromedian setae. Sensillary bases in advance of posterolateral setae. Sensillae with conspicuous and somewhat divergent basal barbs, and with 8-10 long branched on the distal two-thirds. Scutal measurements of holotype: AW-62, PW-64, SB-23, ASB-32, PSB-23, AM-38, AL-42, PL-60, S-54.

LEGS: Coxae with punctae; other segments with few punctae or none. Coxae unisetose. Nude setae on legs: Leg I, 2 genualae, 1 microgenuala, 2 tibialae, 1 spur, 1 microspur, 1 subterminala, 1 parasubterminala, 1 pretarsala; Leg II, 1 genuala, 2 tibialae, 1 spur, 1 microspur, 1 pretarsala; Leg III, 2 genualae, 1 tibiala.

SETAE: Dorsal setae slender and feathered, similar to the posterolateral setae. Dorsal setae in seven rows; dorsal setal formula: 2-14-10-8-8-6-4. Sternal setae 2-2. Ventral setae behind sternal setae 50-55.

DISTRIBUTION AND HOSTS: In Japan known only from the type collection. Taken also in southern Korea from the type host.

TYPE DATA: Holotype and two paratypes from *Rhinolophus ferrum-equinum* (Schreber); near Ohara, Kyoto Prefecture; August 26, 1952; collected by Y. Shogaki and J. McClendon. Holotype in the United States National Museum; paratypes in Rocky Mountain Laboratory (Hamilton, Montana) and Institute for Infectious Diseases, University of Tokyo (Tokyo).

REMARKS: The specific name is the Japanese word for bat.

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